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ZCOPY: No-Cost PC-to-PC File Transfer Utility

MAGAZINE

VOLUME 8 NUMBER 4
FEBRUARY 28, 1989

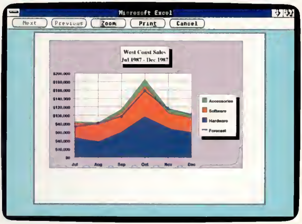
- Price Break!
  6 Complete 386 Systems
  For Under $3,500
- Ready for the Future:
  3+Open LAN Manager
  Brings OS/2 to Networks
- Wise Investment?
  7 Film Recorders
  For Under $15,000
- First Looks Preview:
  Word 5.0 Guns
  For WordPerfect

= POWER

The Software Side of the 386 Equation: PC Labs Tests Five 386-based Multitasking Solutions

This is abou

Microsoft Excel. Or, how to see Lotus 1-2-3 Release 3 from a whole new perspective.



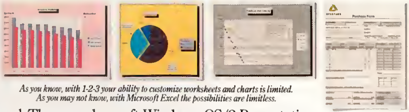
At this moment, millions of Lotus® 1-2-3® users are faithfully awaiting the arrival of a product called Release 3. A character-based product that promises greater power and greater productivity for serious spreadsheet users.

As soon as it gets here.

In the meantime, we have a question:

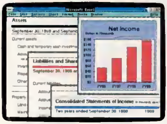
If Release 3 is in fact character-based, and the entire personal computing industry continues moving toward *graphics*-based environments, is it wise to wait for Release 3? Or consider the alternative.

Actually, you can do both. Because you have nothing to lose by seeing the other side of the spreadsheet story, and trying it for yourself.



As you know, with 1-2-3 your ability to customize worksheets and charts is limited. As you may not know, with Microsoft Excel the possibilities are limitless.

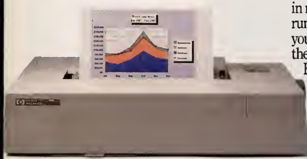
It's called Microsoft® Excel. The spreadsheet specifically designed for graphic environments—the industry's emerging standard. Five minutes in front of a demo will show you the fastest, easiest, most enjoyable way to crunch your numbers. Thanks to an incredibly intuitive design that exploits innovations like Microsoft Windows, OS/2 Presentation Manager and, of course, the Macintosh.®



Unfortunately, 1-2-3 won't let you move, size, and link an unlimited number of files at the same time. Fortunately, Microsoft Excel will.

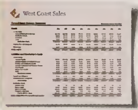
You're a loyal Lotus user. If you're a bit skeptical, we fully understand that. We also anticipated it. So we've made sure your hard-earned equity in 1-2-3 is not obsolete. In fact, we've not only made a transition to Microsoft Excel attractive, we've also made it easy: Microsoft Excel actually reads and writes

t Lotus 1-2-3.



No more wasted trips to the printer. Microsoft Excel comes with Print Preview for true WYSIWYG. Unlike Release 3.

1-2-3 files and even helps translate macros. It also offers the convenience of 1-2-3 on-line help—so you can expect a surprisingly smooth transition. In fact, the slash key you punch to access your 1-2-3 commands is the same key that can access Microsoft Excel commands—you don't have to relearn a thing.



Yes, graphics-based Microsoft Excel was designed around a mouse. You can also use it without one.

Another issue: hardware.

As Lotus may or may not have told you, Release 3 will need a substantial investment in new hardware. The same hardware that runs Microsoft Excel. All we're saying is, if you're committing to new machines, make the most of those new machines. Something Release 3 simply won't.

But, using is believing. So we've made it convenient to get a sample of Microsoft Excel in your hands. Simply call us at (800) 541-1261, Dept. J14 for a free sample disk of your own. It's worth the call. It's worth the experience.

In fact, we're so confident about Microsoft Excel that we're offering a no-questions-asked, money-back guarantee good through January 1990. Which means we're actually willing to guarantee our current technology against Lotus technology that isn't even available yet.

For even more convincing, call for a sample disk. The disk is free. But the experience is priceless.

All of which brings us to a decision millions of you are about to face:

Upgrade to character-based Release 3, or upgrade to the power and simplicity of a graphics-based spreadsheet. We're not saying it's an easy decision.

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CIRCLE 163 ON READER SERVICE CARD

WHAT'S INSIDE

PC watch: Executive editor Gus Venditto tracks industry trends from *PC Magazine*'s New York City headquarters.

Photograph: Thom O'Connor

Last March *PC Magazine* introduced Pipeline, a colorful addition to the First Looks section. It quickly became one of the magazine's most popular features.

Executive editor Gus Venditto, the man behind Pipeline, points out: "*PC Magazine* is introspective by nature. We take products and evaluate them under controlled circumstances. Pipeline gives a different perspective than what we normally provide. It's a place where we can look ahead to the technology we *will* be writing about."

Pipeline is also the place where many of the contacts that Venditto made in his role as editor of the First Looks section (throughout 1987 and into 1988) drop hints and give clues about upcoming products. His analysis, based on what he learns at insider meetings, demos, and press conferences, sums up the direction of the entire industry.

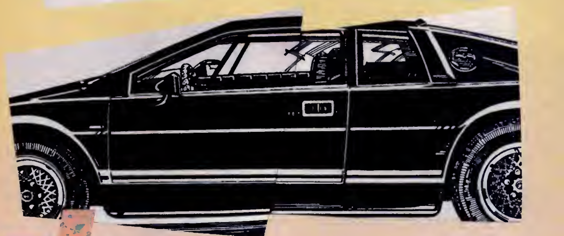
Predicting the future with any success, however, requires a good understanding of what people are doing today. The Top Ten Sellers list, compiled with data from Ingram Software and PC Connection, is a great tool for spotting trends in software. It's an instant read of what's hot now and what's been hot over the past 5 weeks.

The PC MagNet survey results are equally important because they indicate how readers are using their products and how they feel about them. As Venditto explains, "More than 40,000 readers have joined PC MagNet, and when a survey is taken, the connect time is free to encourage broad participation. We always get a really good response, and as Pipeline evolves, we'll be doing even more research into how satisfied readers are with their systems."

ANOTHER FREE UTILITY After you finish checking out the news in Pipeline, be sure to flip to this issue's Productivity section, where Bob Flanders, our newest contributor, makes his debut with one of our best utilities ever. Flanders, a telecommunications and protocols expert, has created ZCOPY, a simple utility to transfer data from one PC to another at high speeds via the serial ports. **—Stephanie Izarek**

PC Magazine: The Independent Guide to IBM-Standard Personal Computing ISSN (#0888-8507) is published bi-weekly except in July and August for $39.97 for one year (22 issues), $61.97 for two years, and $81.97 for three years. Additional postage $1.00 per copy or $22.00 per year for Canada and all other foreign countries. Ziff-Davis Publishing Co., a division of Ziff Communications Co., One Park Ave., New York, NY 10016. Second-Class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 54093, Boulder, CO 80321-4093

These unretouched print samples show the superior print quality of QMS-PS 810 over printers using first-generation print engines.



Introducing the PostScript laser printer that blacks out at high speeds.

The new QMS-PS® 810 can compose and print the most complex pages in record times, with richer, more saturated blacks than ever before. All with the desktop publishing power of Adobe PostScript®, and the superior print know-how of QMS, an industry leader.

Under the hood QMS ASAP™ (Advanced System Architecture for PostScript) is proprietary technology that helps eliminate the hardware bottlenecks that hinder other PostScript printers. As a result, QMS-PS 810 boasts processing speeds remarkably faster than other PostScript printers in its class. And faster output means greater productivity. In addition, the QMS-PS 810 laser printer's new Canon® SX® print engine covers solid areas and prints fine detail better than previous-generation engines.

The new 8-page/minute QMS-PS 810 laser printer

Fast start, strong finish You can adorn your documents with one or all of the 35 Adobe typefaces. Thanks to PostScript, there's an infinite number of font variations available. You can also make type as large or as small as you want. And put it anywhere on the page. In fact, with PostScript you enjoy total control over the design of your page. It gives you the complete desktop publishing power to do things that would otherwise be virtually impossible. So you get high-quality output exactly how you want it.

Along with PostScript, the HP LaserJet+™, Diablo® 630 and HP-GL™ printer emulations are added for your non-PostScript software.

The QMS-PS 810 laser printer is easy to use, maintain, and comes with a one-year warranty. It's available from Laser Connection dealers. Laser Connection is a sales and marketing subsidiary of QMS. For the dealer nearest you call **1-800-523-2696**.

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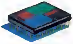
VOLUME 8 NUMBER 4

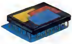
PC MAGAZINE

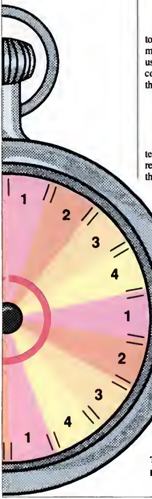
COVER STORY

When One PC Equals Four: 386 Multitasking Environments

Stephen R. Davis and Winn L. Rosch/ The 386 chip is not just a faster 286; its unique ability to simulate many virtual DOS machines within one PC means users can run their applications concurrently—all they need is the right software. PC Labs tests five DOS enhancers and replacements that fit the bill and that make multitasking a reality now 94







The secret to multitasking is processor time-slicing, page 94.

FEATURES

COMPUTERS

The Midrange Has Moved: 386s Become Affordable

Bruce Brown and Stephanie K. Losee/ The best excuse for not buying a 386 computer used to be price. Now there's no excuse. PC Labs evaluates six fully configured 386 computers under $3,500 from Altec Technology, CompuAdd, Dataworld, HiTech International, Tussey Computer Products, and Zeos International 145

CONNECTIVITY

Building Workgroup Solutions: 3Com's 3+Open LAN Manager

Frank J. Derfler, Jr./ Does 3Com's OS/2-based *3+ Open LAN Manager* pose a serious challenge to Novell's *NetWare* in the PC LAN market? Is 3Com leading the march to the future? PC LAN Labs examines the first network operating system that lets users combine DOS workstations with OS/2 servers 177

3+Open LAN Manager: **A pioneering OS/2 application, page 177.**

Cover Photography:
Thom O'Connor

HARDWARE

From Screen to Slide—Affordably

Henry Fersko-Weiss/ With prices ranging from $5,000 to just over $14,000, film recorders aren't cheap, but in the right corporate setting there's no more cost-effective way to produce truly presentation-quality slides. *PC Magazine* evaluates seven of the leading models 199

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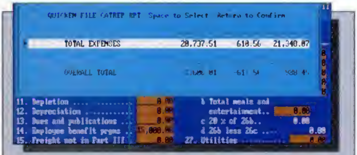
A list of products reviewed in this issue, plus a guide to utilities, programs, and tips in the Productivity section ... 372

FIRST LOOKS

AFTER HOURS

PRODUCTIVITY



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Fail-Safe Transmission. The ITC 286 CAT has a built-in cellular telephone, plus an error-correcting modem that let you trust your valuable data to the cellular network. So there's nothing lost in transmission — even during hand-off and channel changes.

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back-lighted, 640 x 400 EGA screen; full-sized keyboard with numeric keypad and much more. Need a printout? Just plug in your portable printer.

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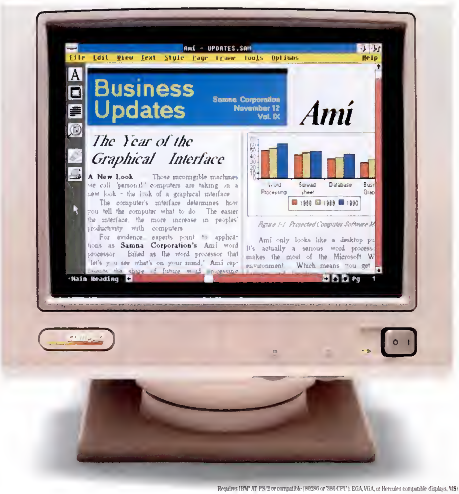


The Year of the Graphical Interface

A New Look Those incorrigible machines we call 'personal' computers are taking on a new look - the look of a graphical interface.

The computer's interface determines how you tell the computer what to do. The easier the interface, the more increase in peoples' productivity with computers.

For evidence, experts point to applications as **Samna Corporation's** Amí word processor. Billed as the word processor that "let's you see what's on your mind," Amí represents the shape of future word processing

Figure 1-1 Projected Computer Software M

Amí only looks like a desktop pu It's actually a serious word process makes the most of the Microsoft W environment. Which means you get

Requires IBM® AT PS/2 or compatible (80286 or '386 CPU); EGA, VGA, or Hercules compatible displays, MS/DOS 3.0 or higher

All of us want beautiful, professional-looking results from our word processing.

But who has time for the processing?

Who has time to manipulate columns and margins, align paragraphs, justify lines, tinker with leading, insert graphics and wrap text?

Let's face it. Writing is hard enough without having to struggle with formatting when you're finished.

Well, now you don't have to.

Because now there's a word processor that lets you create your words and your page layouts *at the same time*—as one intuitive train of thought.

While making the entire process easier, friendlier and more accessible than you ever dreamed possible.

Also a whole lot faster.

In fact, Amí™ is designed to save you about three quarters of the time—and effort—you're currently spending on everything from simple letters and memos to presentations, reports and multi-column newsletters.

For people who do Windows. And people who don't.

With its WYSIWYG screen display, powerful use of frames and interactive dialog boxes, Amí looks a lot like a desktop publisher.

But it's actually a serious word processor that makes the most of the Microsoft® Windows environment.

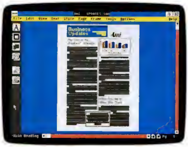
(If you don't have Windows, don't worry. A runtime version is included with Amí.)

Amí gives you everything you need to process words quickly. Like complete and efficient keyboard commands (or mouse, if you insist). A 130,000-word spelling checker. Search and replace. Cut, copy and paste. Headers and footers. Undo functions. Context sensitive help. And much more.

Amí even gives you a choice of ways to write.

In Draft Mode, you can put your head down, get your words into the computer as fast as humanly possible and worry about formatting later.

Layout Mode, on the other hand, gives you instant onscreen formatting, with automatic spacing, fonts, special effects and all the other things we mentioned at the top of this ad.



Now you can easily edit text and graphics and see the results onscreen before you print.

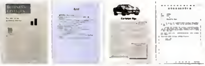
If you'd rather not do any designing, you don't have to. Because Amí comes complete with 25 pre-designed style sheets.

You can use them right out of the box. Modify them. Or create your own.

You can integrate text and graphics. Import both from other programs. And admire your documents from four fully editable page views.

There's no time like the present.

Amí is the next generation in word processing. Yet it sells at a price that would make your grandparents nostalgic.



Amí comes complete with 25 pre-designed style sheets, so writing and formatting time is reduced to practically nothing.

Just $199 suggested retail.

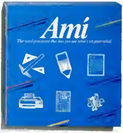
Buy it by March 15, 1989 and you'll pay under $150. No kidding.

We'd be happy to tell you more about Amí and where to buy it.

All you have to do is call.

But hurry. Time's wasting.

For the dealer nearest you, call Samna at 1-800-831-9679.



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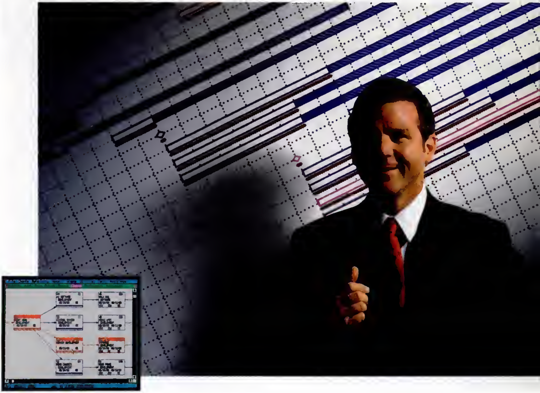
CIRCLE 131 ON READER SERVICE CARD

Announcing Version 1.5

"Project Scheduler™ 4. The difference is graphically clear."™

ROGER MEADE, PRESIDENT, SCITOR CORPORATION



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"I challenged my development team to build a totally new product with unmatched speed, power, and ease-of-use. They met this challenge with Project Scheduler 4.

"Project Scheduler 4 is the first PC-based package that integrates high-resolution graphics with all the management tools you need. You understand more because you see more on the screen. At last, PERT and Gantt charts make sense. And responsibilities, deadlines, and resource bottlenecks are all spotted at a glance.

"You see more on paper, too. Project Scheduler 4 gives you graphic reports that minimize tedious cut-and-paste assembly. They're instantly understandable. Not to mention simple to generate for impressive presentations.

"Because scheduling is primarily a visual process, Project Scheduler 4 uses an intuitive, graphic interface that gives you a clear view of the big picture. Gone are hard-to-remember commands and keystroke sequences. Here is the future of advanced productivity tools."

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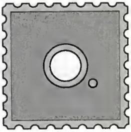
LETTERS TO PC MAGAZINE



MORE SOFTWARE, HOLD THE 386s

Stephen Manes's column ("'Just Tech' vs. Reality: Who Wins?" *PC Magazine*, November 15, 1988) was an enjoyable and all too familiar description of those vendors who would have us buy their facile solutions to our nonexistent problems.

A most rampant example of "just tech" can be seen on cover after cover of *PC Magazine*. Please spare us another cover story raving about the latest batch of 386 "screamers" to hit the market, and put more effort into application-oriented material, such as your excellent software reviews.

"JUST TECH" VS. REALITY: WHO WINS?

Peter Laight
Whitehorse, Yukon Territory
Canada

IN DEFENSE OF EDLIN

I'm getting a little fed up with all the bad-mouthing of EDLIN that keeps cropping up as periodically as the four seasons. The latest attack was made by Tom Kihlken, who stated that "EDLIN is a dog to use—even if you can remember how" ("The Tiniest Editor You'll Ever Need," *PC Magazine*, November 15, 1988).

EDLIN is as much superior to TED, upon which the Productivity column expounded, as Leonardo da Vinci is to Pablo Picasso! For instance, what would you rather do? Type in a simple command or go through toggling, cursor-movement, area-removal, and another location-paste to achieve the same function?

Al Yackabonis
Arlington, Virginia

BACK UP A FEW STEPS

I believe some important facts were left out of Henry Fersko-Weiss's review of *DS Backup Plus* ("Software Safety Nets," *PC Magazine*, May 31, 1988).

SpeedBak, the fast version of this program, is of little use to owners of XTs because the I/O is not fast enough to make proper use of this function. The software is supposed to write in DOS-readable format, but it is still unreadable by anything but itself. It also does not support 3½-inch drives, which I found annoying.

I believe these faults of *DS Backup Plus* should have been mentioned in the review. If they had, I for one would not have purchased this program.

Bill Thomas
Pittsburgh, Pennsylvania

A CAUTIONARY NOTE

A word of caution to prospective buyers of MIDI boards and software: make certain that your computer has not used IRQ#2 for other system purposes ("A MIDI Musical Offering," *PC Magazine*, November 29, 1988). All Roland and compatible MIDI cards use IRQ#2, and *Cakewalk* is the only MIDI sequencer that allows the user to determine which interrupt is addressed by the software. Although a number of MIDI cards can be reconfigured to use an alternate interrupt, this is pointless if the software does not recognize the altered configurations.

A MIDI Musical Offering

Larry Bachtell
Perkasie, Pennsylvania

I must compliment you on the excellent coverage you have given to the world of MIDI software ("A MIDI Musical Offering"). However, there's one element that can't be accounted for in any MIDI software package. Musicians are a touchy bunch and music is created in spur-of-the-moment inspirations. If you can't get a package up and running before the melody leaves your head, forget it. No matter how many bells and whistles a product might have, a musician is going to use the one that "feels good" to him.

Jeff Roberts
Trumbull, Connecticut

SEPARATING BITS FROM BYTES

Congratulations on Richard Hale Shaw's excellent Productivity article on modems ("The PC User's Guide to Modems," *PC Magazine*, November 29, 1988).

One point touched on in this article seems to cause a great deal of confusion among users. Modem speeds are in *bits* per second while file speeds are in *bytes*. This difference is important in long-distance communicating. At 1,200 bits per second, it takes nearly 15 minutes to transmit a 100K file, while running up your long-distance bill. The extra money spent for a faster modem may really be a bargain.

Bob Fields
Westlake, Ohio

KEEP THE UTILITIES COMING

Finally an answer to some of those bothersome DOS limitations! I just got the new *PC Magazine* Utilities Disk and was very impressed. Keep up the good work and let's see some more of these goodies in the mail.

Dirk Wakeham
Placentia, California

■ LETTERS

THANK YOU FOR YOUR SUPPORT

After reading Bill Machrone's Viewpoints column ("Support: The Stumbling Block," *PC Magazine*, November 29, 1988), I realized that you are playing the game by the manufacturers' rules, which is a decided disadvantage to the customer.

What I always do, when preparing to make a substantial purchase, is call the customer service department of the manufacturer. I pretend that I have already purchased the equipment and ask for help on a problem. I then determine the proficiency of the representatives and the treatment that customers are afforded, and make my purchasing decisions accordingly.

SUPPORT THE STUMBLING BLOCK

Richard Metien
Culver City, California

If you want to rate computer products or support, you will need to sample the opinions of large numbers of readers ("Support: The Stumbling Block"). I recommend you look at how *Consumers Report* from Consumers Union does its automobile ratings. They mail out extensive questionnaires to their members. The results are then tallied, graded, and reported in their annual Buyer's Guide. With your readership, you should be able to make a conclusive survey.

Stanley Schwartz
Tulsa, Oklahoma

Bill Machrone's comments on support were timely ("Support: The Stumbling Block"). I thought I was alone in my negative experiences. I am a relative newcomer to computers who bought an IBM PS/2 Model 30. The user guide is essentially useless. The IBM manual for DOS 3.3 is perhaps the worst example of manual writing I've ever seen and Microsoft's DOS tutorial is a joke. One disk in three is devoted to plugs for Microsoft products, and the tutorial is elementary. And my experiences with *WordPerfect* 5.0 have me convinced that it is still a beta version.

David A. Anderton
Ridgewood, New Jersey

The answer to the question about support is that acceptable support is the level of support that you *expect* ("Support: The Stumbling Block"). Unacceptable support is simply the amount of deviation from what you thought you would get. In the absence of any criteria, you make up your own standards, which probably differ from the next person's ideas about support.

To ensure realistic support expectations, purchasers should look for indications that the manufacturers have some written support standards in marketing literature or user documentation. They may also broadcast their negative and positive experiences to the manufacturer, the trade press, and others and should actively seek remedies and restitution for problems.

Brian P. Murphy
St. Paul, Minnesota

LOTUS KEEPS IT SIMPLE

I do not quite agree with the statement "*Excel*'s handiest graphing feature is its intelligence" ("Battle of the Spreadsheet Stars," *PC Magazine*, November 15, 1988). Anyone who tries to make a simple and basic *x-y* plot, which is called a scatter chart in *Microsoft Excel*, would find himself in an awkward situation, especially when *y* data and *x* data are separated by several columns. As a physicist, I find the way of specifying plotting ranges in *Lotus 1-2-3* more natural and straightforward. For that reason, I cannot give up *1-2-3* totally.

BATTLE OF THE SPREADSHEET STARS

Pamela Kung
Palo Alto, California

NOTHING PERSONAL . . .

Despite *PC Magazine*'s prestigious position, criticism is increasing that your reviewers are letting personal tastes excessively bias their evaluations of new products and, without objective evaluations, your credibility suffers. The review of Borland's Turbo Assembler and Turbo Debugger is a perfect example (First Looks, page 34, *PC Magazine*, November 15, 1988).

Although I highly respect Robert L.

THE BUS STOPS HERE!

CompuStar: PS/2 *and* PC/AT Compatibility.

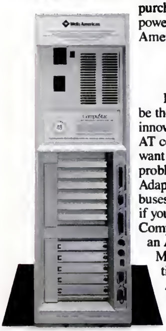
Ask any computer expert about what type of system you should buy nowadays and you'll likely get a "pass the bus" response. Something like — "Well, uh, the PC/AT* bus is your best buy but, then again, the new PS/2* bus may become the next industry standard." Great advice, right? If trying to decide on a microprocessor weren't tough enough, now you're expected to pick a bus, too.

RELAX, NOW THERE'S COMPUSTAR®.

The all new CompuStar from Wells American not only lets you interchange microprocessors, you can also mix and match buses — a PC/AT bus, a PS/2 bus or. . .both. As your computing needs change, simply snap in a new processor or add an extra bus. You'll never again have to worry about buying the *wrong* computer system!

FOUR COMPLETE SYSTEMS IN ONE.

The CompuStar can be configured with any of four microprocessors — an 8086, an 80286, an 80386SX, or an 80386. The processor and up to *16* megabytes of user memory have all been combined, using the latest VLSI technology, on a single, plug-in CPU module. Plus, any time during the first year of ownership, CompuStar users can "trade-in" the CPU module they initially selected toward the purchase of any of the other more powerful modules. *Nobody* but Wells American gives you this kind of value.



A CONVERTIBLE BUS? YOU'RE KIDDING!

No, we're not. In fact, it may well be the most practical microcomputer innovation ever. Say you've selected an AT compatible CompuStar and later want to add PS/2 compatibility. No problem! Snap in a PS/2 Bus and Adapter Module and you can use *both* buses in the same system. Likewise, if you've selected a PS/2 compatible CompuStar and decide you want to add an AT bus, just snap in an AT Bus Module. Depending on configuration, the CompuStar can have up to *13* bus expansion slots — all AT slots, all PS/2 slots or a "split-bus" of AT *and* PS/2 slots. No matter which bus becomes the next industry "standard," you'll have peace of mind knowing your investment in a CompuStar will be protected.

The CompuStar is also easily expanded. That's because there are *seven* CompuStar disk/tape compartments — six accessible from the front and an additional full-height bay inside. All this in a sleek, compact tower design that will leave *more* room on your desktop than any of the so-called "desktop" models.

A NEW IDEA FROM AN OLD COMPANY.

The CompuStar® Multi-Processor, Convertible Bus™ Microcomputer. It's no surprise that our engineers invented it. After all, we've been making microcomputers longer than anyone else. . .even longer than IBM! And if that kind of experience doesn't impress you, CompuStar's service programs surely will. You can select an optional overnight module swap-out plan or on-site service from General Electric Corporation — one of the most respected names in consumer electronics. And, of course, every CompuStar carries a full one-year factory warranty.

FINALLY, AFFORDABLE TECHNOLOGY.

Think all this technology sounds expensive? It's not. CompuStar 20MHz 80286 systems start as low as $1995†. There are also inexpensive 8086 and powerhouse 25MHz 80386 systems available. Plus, there is a wide variety of CompuStar display, tape and disk options including a one gigabyte erasable optical disk. You can choose a factory pre-configured CompuStar or custom design one yourself. Just unlock the front panel and literally "snap-in" a bus, CPU, memory or disk module in a matter of seconds. It's system flexibility never before available. . .at *any* price.

While one of our competitors (we won't mention any names) threatens you with "missing the bus," most simply *pass* the bus. Our new CompuStar, however, *eliminates* the bus problem altogether. Not to mention the processor problem. Even the expansion problem. Prove it to yourself. Call today about our 31-day trial offer. Oh, and by the way, the next time anyone asks, tell 'em you know where the bus stops.

Wells American

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*Personal Computer AT, AT and PS/2 are trademarks of International Business Machines Corporation. †Photographs depict optional equipment. A complete price list is available upon request. CompuStar 80286 system ($1995) includes an AT Bus Module, built-in VGA/EGA display adapter, one diskette drive with controller, two serial/one parallel/one mouse port, keyboard and 220 watt power supply.

CIRCLE 515 ON READER SERVICE CARD

■ LETTERS

Hummel's contributions to *PC Magazine*, his "hating" the program is from the perspective of a very experienced programmer, not a beginner. He is entitled to his view, but to title the article "... Unworthy Documentation" is clearly too opinionated. The books are well suited to the program, and I suspect that beginning assembly language programmers will like them much more than MASM.

Phillip Anderson
Payson, Arizona

THANKS, I'LL KEEP MY AT

Until a critical mass of software exists exclusively for the 386, why spend the money to switch ("PC Magazine vs. the Readers," Bill Machrone, *PC Magazine*, November 15, 1988)?

I suspect there are millions of users who are neither pencil-neck geeks nor sweating, short-armed fatties from the MIS Department (that is, those of us who live useful, productive lives despite the handicap of AT-level performance). These users are probably going to soldier along without a 386 or OS/2 until funeral arrangements are complete for the 20th century.

> ■ Until a critical mass of software exists exclusively for the 386, why spend the money to switch?

Ralph Foxnose
Southampton, New York

BLINDED BY SCIENCE

Judging from recent letters in your magazine, I am not alone in my belief that *PC Magazine* does not adequately cover the needs of the scientific/technical community. You claim to be changing this, but you have not gone nearly far enough.

There should be something in each issue applicable to science or engineering, be it short algorithms or a review of a statistical package. Anything would be better use of print space than the 10,000 ways you've shown us to change the date in a Lotus spreadsheet.

Steven Arnold
Mesa, Arizona

LOOK, UP IN THE SKY ...

I happened to be in need of an additional PC when I read the August issue ("Compaq's Deskpro 386S: Less Is More," *PC Magazine*, August 1988). I was already sold on Compaq, but I didn't even know this machine existed!

I held out for the 386S and I love it. There are others that are faster or cheaper, but I don't care. I think the "S" should stand for "super" because that's what this product is.

Herb McNaspy
Houston, Texas

CREDIT FOR KERMIT

Jim Seymour seems to have mixed up his Muppets ("PS/2 Clones: Time to 'Hedge and Straddle'?" *PC Magazine*, November 15, 1988): Oscar the Grouch is on "Sesame Street." The lyric Seymour quotes is from the song "I Hope That Something Better Comes Along!" which was performed not by Oscar the Grouch but by Ralph the Dog and Kermit the Frog in *The Muppet Movie*. (I know, you mistook Kermit for Oscar.)

Lee Stevens
Greenwood, Indiana

CORRECTIONS/AMPLIFICATIONS

Eaasy Sabre and the Official Airline Guide are also available on The Source (After Hours, *PC Magazine*, November 15, 1988).

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the Productivity section for access information).

All letters become the property of *PC Magazine* and are subject to editing.

Swan Technologies

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Base System with 1.2MB Drive,
Assembled & Tested IBM® AT Compatible
MS-DOS®, OS/2® Compatible

- 80286 12/6 MHz
- Phoenix BIOS
- 512K of RAM Expandable to 1MB
- 0 Wait State
- 200W Power Supply
- 1.2MB Floppy Drive
- Ports: 1 Serial, 1 Parallel, 1 Game
- Dual Floppy/Dual H.D. Controller
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- Swan Setup & Utilities Diskette

Options:

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286/12	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	EGA	VGA
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w/40MB (40ms) Harddrive	$1649	$1898	$2048	$2148
w/80MS (28ms) Harddrive	$1949	$1998	$2348	$2448

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$549 *Monitor not included*

10MHz/0 Wait State

Base System with Single 360K Drive,
Assembled & Tested IBM ® XT Compatible

- 8088-1 10/4.77 MHz
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- 640K of RAM
- 150W Power Supply
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- 8 Expansion Slots
- Single 360K Floppy Drive
- 101 Key Enhanced Keyboard
- Clock Calendar w/Battery Backup
- Swan Setup & Utilities Diskette

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XT10	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono¹	CGA	EGA	VGA
Single Floppy	$699	$869	$1098	$1198
Dual Floppies	$779	$949	$1178	$1278
*w/20MB (65ms) Hard Drive	$979	$1149	$1378	$1478
*w/30MB (65ms) Hard Drive	$995	$1165	$1394	$1494

* Includes Single 360K Floppy Drive
¹ Upgrade from 12" to 14" Flat Screen, add $49

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16MHz/0 Wait State

Base System with 1.2MB Drive,
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- 80386 16/8 MHz Norton V4.0 SI 17.6
- Phoenix BIOS
- 1MB expandable to 18MB RAM on 32 bit memory card
- 80287 & 80387 Coprocessor Socket
- 200W Power Supply
- 1.2MB Floppy Drive
- Ports: 1 Serial, 1 Parallel, 1 Game
- Dual Floppy/Dual H.D. Controller
- 8 Expansion Slots
- 101 Key Enhanced Keyboard
- Clock Calendar w/Battery Backup
- Swan Setup & Utilities Diskette

Options:

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386/16	VIDEO OPTIONS Include Monitor & Video Adapter			
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w/40MB (40ms) Harddrive	$2549	$2595	$2799	$3048
w/80MB (28ms) Harddrive	$2849	$2898	$3099	$3348

Swan 286/10

$999 *Monitor not included*

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Base System with 1.2MB Drive,
Assembled & Tested IBM® AT Compatible
MS-DOS®, OS/2® Compatible

- 80286 10/6 MHz Norton V4.0 SI 11.2
- Phoenix BIOS
- 512K of RAM Expandable to 1MB
- 200W Power Supply
- 1.2MB Floppy Drive
- Ports: 1 Serial, 1 Parallel, 1 Game
- Dual Floppy/Dual H.D. Controller
- 8 Expansion Slots, 8x16 bit, 2x8 bit
- 101 Key Enhanced Keyboard
- Clock Calendar w/Battery Backup
- Swan Setup & Utilities Diskette

Options:

- 80287 Coprocessor
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- 31/2" Floppy Drive
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286/10	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono¹	CGA	EGA	VGA
Single Floppy	$1145	$1315	$1544	$1644
w/20MB (65ms) Harddrive	$1399	$1569	$1798	$1898
w/40MS (40ms) Harddrive	$1549	$1719	$1948	$2048
w/80MB (28ms) Harddrive	$1849	$2019	$2248	$2348

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$2499 *Monitor not included*

20MHz/0 Wait State

Base System with 1.2MB Drive,
Assembled & Tested IBM® AT Compatible
MS-DOS®, OS/2® & UNIX® Compatible

- 80386 20/8 MHz Norton V4.0 SI 22.0
- Phoenix BIOS
- 1MB expandable to 18MB RAM on 32 bit memory card
- 80287 & 80387 Coprocessor Socket
- 230W Power Supply
- 1.2MB Floppy Drive
- Ports: 2 Serial, 1 Parallel, 1 Game
- Dual Floppy/Dual H.D. Controller
- 8 Expansion Slots
- 101 Key Enhanced Keyboard
- Clock Calendar w/Battery Backup
- Swan Setup & Utilities Diskette

Options:

- Upgrade to 2,4,8,10,18MB
- 80287 or 80387 Coprocessor
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- SWAN/MS-DOS (3.3) add $89

386/20	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	VGA Color
Single Floppy	$2649	$2698	$2899	$3148
w/40MB (40ms) Harddrive	$3049	$3098	$3299	$3548
w/80MS (28ms) Harddrive	$3349	$3398	$3599	$3848

SWAN VIDEO OPTIONS INCLUDE:

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- Tilt & Swivel Base

14" MONOCHROME:

- Swan Switchable Video Card
- 14" Flat Screen Monitor
- Tilt & Swivel Base

CGA

- Swan Switchable Video Card
- RGB Monitor

EGA

- Swan EGA Video Card
- 14" EGA Monitor

VGA

- Swan VGA Video Card
- 14' VGA Monitor
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Swan Modems

w/PC Talk III software

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2400 baud internal $129
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EGA

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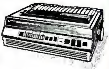

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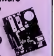

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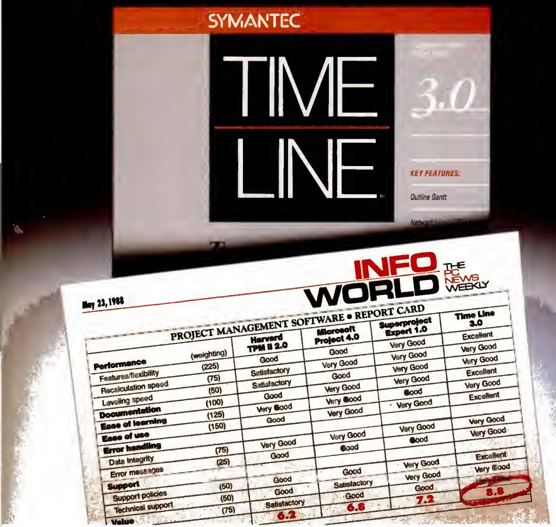

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Ease of learning	(125)	Very Good	Very Good	Good	Very Good
Ease of use	(150)	Good	Very Good	Very Good	Excellent
Error handling					
Data integrity	(75)	Very Good	Very Good	Very Good	Very Good
Error messages	(25)	Good	Good	Good	Very Good
Support					
Support policies	(50)	Good	Good	Very Good	Excellent
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PC MAGAZINE *Editor's Choice, '86, '87 and '88*

■ JOE DESPOSITO

PC ADVISOR

Advice on transferring Word documents between a PC and Macintosh, help in locating a Dvorak keyboard, and suggestions for programming digitized speech on a PC.

USING WORD ON THE PC AND MAC

I want to transfer a document created with *Microsoft Word* on an AT&T 6300 to an Apple Macintosh. Are there methods other than using a modem to transfer the files? The PC is at home, while the Mac is at the office. Could I attach a 3½-inch disk drive to the second connection on the 6300 controller? Is there software that would reformat the DOS *Word* file on the hard disk to a Mac-compatible format on the floppy disk drive?

Karl Dash
Cypress, California

The best way to accomplish this task is to add a 5¼-inch disk drive to the Macintosh. Apple Computer (20525 Mariani Dr., Cupertino, CA 95014; (408) 996-1010) sells an add-on 5¼-inch MS-DOS drive for a suggested retail price of $395. You take the floppy disk from your AT&T 6300, put it in the Apple MS-DOS drive, use the Apple File Exchange program to move the file to your Macintosh disk, and then call up the file with Word. Word *on the Mac automatically translates PC-generated* Word files.

If you want more flexibility, you should consider DaynaFile from Dayna Communications (50 S. Main St., Salt Lake City, UT 84144; (801) 531-0600). DaynaFile is an add-on peripheral that plugs into the Apple Macintosh's SCSI port and contains one or two 5¼- or 3½-inch disk drives, either high- or low-density formats. PC-originated files will come up on the Macintosh display, and they can be opened by appropriate Mac applications. In the DaynaFile, files are saved to floppy disks as normal DOS files.

Programs with common file structures for the PC and the Mac, such as Microsoft Word, *can read and work with transferred files immediately. For programs with incompatible file structures and no built-in conversion routines, Dayna supplies conversion software that can handle some exchanges, such as* WordStar *and* MultiMate *on the PC to and from* MacWrite *and* MacWord.

Suggested retail price of the least expensive DaynaFile—with one 360K floppy disk drive—is $650. The most expensive model—with two 1.44MB drives—lists for $1,005.

THIS IS YOUR PC SPEAKING

I'm interested in a software and/or hardware package that would enable me to program digitized speech in an AT computer. This hardware and/or software should have the capability, programmable or otherwise, to translate inputted text in English to digitized human voices. The outputted voice could be in any language (English, Japanese, or Arabic).

■ Speech Thing permits prerecorded digitized words to be incorporated into BASIC programs, and an editor allows for special effects.

What recommendations could you provide that are reasonably priced and reliable? Does such a package exist as a plug-in expansion board with software to drive and program it?

Bernard Ong
Cypress, California

One product that might help you out is called Speech Thing from Covox (675 Conger St., Eugene, OR 97402; (503) 342-1271). Speech Thing is an 8-bit digital-to-analog sound converter that attaches to the parallel port on your PC, attaching in line so that it doesn't interfere with normal printer operation. Prerecorded digitized words can be incorporated into user-written BASIC programs. An editor allows for special effects, new words, and music.

The system includes an audio amplifier/speaker with headphone jack, power cable, software, and manual. Also included is the SmoothTalker *software, which gives you unlimited text-to-speech capability. Suggested retail price of Speech Thing is $79.95.*

Another Covox product is Voice Master, a plug-in board for recording your own words or music; the recorded material plays out of Speech Thing. A digitized word takes up about 2K of memory. Phrases can be recorded in 64K buffers and then linked together to get continuous

■ PC ADVISOR

speech output. (For Japanese and Arabic voice output, you would have to first prerecord words and phrases in those languages and then incorporate them into a BASIC program.) Voice Master's list price is $89.95.

DVORAK ON THE KEYBOARD

My question concerns keyboard hardware. Specifically, I am looking for IBM-compatible keyboards that have the Dvorak configuration. Where can I get one and how much do they cost?

Doug Stroud
Amherst, New York

The Dvorak keyboard was designed as an intelligent alternative to the standard QWERTY keyboard. The QWERTY model, which was designed in the 1800s, spreads out most of the commonly used keys over three alphabetical rows, supposedly because manual typewriter mechanisms couldn't keep up with fast typists. The Dvorak keyboard, on the other hand, places the most frequently used letters on the "home" keys, thus increasing touch-typing speed.

One company that sells a Dvorak keyboard is Key Tronic (P.O. Box 14687, Spokane, WA 99214; (509) 928-8000). The keyboard is the KB 5151 for the IBM PC-XT and compatibles. Additionally, you will need to use the Dvorak conversion kit, which includes a replacement chip and keycaps. The keyboard has a suggested retail price of $199; the conversion kit sells for $35. The keyboard can also be upgraded to work with the IBM PC AT for another $15.

Before investing in hardware, you might want to try a keyboard macro program. Such programs let you redefine any key so that it will respond with some character other than that on the keyboard. Examples of these programs are Keyworks, *Version 3.0, from Alpha Software Corp. (30 B St., Burlington, MA 01803; (617) 229-2924), which has a suggested retail price of $89.95, and* SuperKey, *Version 1.16a, from Borland International (4585 Scotts Valley Dr., Scotts Valley, CA 95066; (408) 438-8400), which sells for $99.95.* SuperKey *actually contains a sample file for a Dvorak keyboard layout right on the disk.*

If you want to use a Dvorak layout with just your word processor, you should check whether that program will remap the keyboard for you. Examples of word processors that will are XyWrite III Plus *and* Samna Plus IV.

ASK THE ADVISOR

Send your questions to PC Advisor, *PC Magazine*, One Park Avenue, New York, NY, 10016, or upload to PC MagNet (see the Utilities column for access information). Please specify your equipment.

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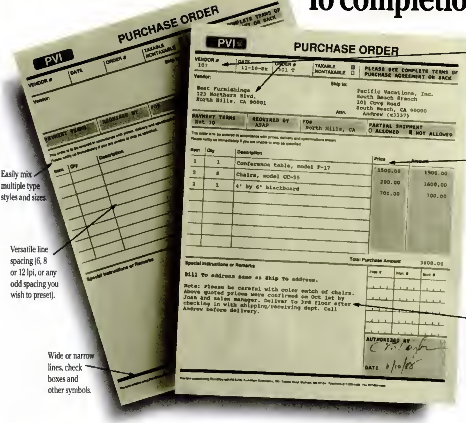

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Bill To address same as Ship To address.

Note: Please be careful with color match of chairs. Above quoted prices were confirmed on Oct 1st by Joan and sales manager. Deliver to 3rd floor after checking in with shipping/receiving dept. Call Andrew before delivery.

Item # Dept # Acct #

AUTHORIZED BY

DATE 11/10/88

Lookup tables automatically enter data so you don't have to.

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Easily fill out forms right on screen and get letter-perfect results. Form after form. Simply tab from blank to blank and type in your data, or merge data from existing dBASE or ASCII files. Entries go exactly where they belong. No overwrites. No misalignments. No "white-out."

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CIRCLE 174 ON READER SERVICE CARD

Forms shown were printed using version 2 5 on an HP LaserJet II with downloaded fonts. Digitized logo printed within FormWorx by invoking a printer macro. Some features shown not available on all printers. **45-day money back guarantee on direct purchases.** When ordering by mail, include $6 75 for shipping in U.S. and Canada. Air mail overseas—$18. In Massachusetts add 5% sales tax. Purchase orders accepted from government agencies, institutions, and rated corporations. FormWorx with Fill & File is a trademark of FormWorx Corporation. dBASE is a registered trademark of Ashton-Tate.

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John C. Dvorak
Columnist, PC Magazine

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Everex Step 386/20	4.91 MIPS

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PC MAGAZINE,
EDITORS CHOICE
JANUARY 31, 1989

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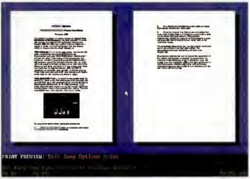
Word 5.0 Gains on WordPerfect With a Host of DTP-like Features

PC PREVIEW

BY CRAIG STINSON

When it finally appears, perhaps in late February, *Microsoft Word*, Version 5.0, will add a broad range of improvements to an already-formidable word processor. The company's explicit objective is ambitious: to raise character-based word processing to the highest-possible functional level without leaving the world's 10-million-plus 8088 users in the dust. The implicit objective is equally ambitious—to grab a little market share from archrival WordPerfect Corp.'s *WordPerfect* 5.0.



The Word 5.0 print preview function supports all standard graphics adapters. The file previewed above includes a graphic set to flow with the text.

Though scheduled to ship at the end of 1988, *Word* 5.0 was held back at the last minute. This preview, based on a functional but shaky beta release, describes new features and enhancements without assessments of reliability or speed.

Of the most-important changes in Version 5.0, the most visible relate to *Word*'s usability as a quasi-desktop publishing system—an area *WordPerfect* 5.0 also strongly attacks. For instance, *Word* 5.0 improves its large-screen support, including drivers for the

(continued on page 34)

Freelance Plus 3.0 Adds Data Links, Device-Specific Preview

PC HANDS ON

BY MARY KATHLEEN FLYNN

Long admired by graphics software users for its drawing functions, Lotus's *Freelance Plus* is now going after business users in a big way. Version 3.0 adds presentation features and expands the charting capabilities first introduced in Version 2.0, broadening its appeal for general business use. Other notable enhancements improve the $495 package's all-around performance.

One of the more-clever enhancements in Version 3.0 is the improved device-specific page preview. Once you tell *Freelance Plus* 3.0 which output device you're using, the print preview command displays a WYSIWYG screen, taking into account how the various fonts and colors you've chosen are implemented with your device. *Freelance Plus* 3.0 supports everything from Hercules to VGA, the Epson FX-80 to the Apple LaserWriter, image recorders like Polaroid Palette and VideoShow, and plotters.

For spreadsheet users, probably the most important addition to *Freelance Plus* is Datalinks, which lets you dynamically link a spreadsheet file to a chart. When you modify the spreadsheet, the chart gets updated automatically, but not vice versa. If you modify the spreadsheet from within *Freelance Plus*, it breaks the link.

Once you've called up a spreadsheet file through Datalinks, it's very easy to switch back and forth between the spreadsheet and the chart form you're filling out. For instance, pressing F6 from the chart form instantly brings up the spreadsheet, a feature you'll greatly appreciate as you're defining chart components.

Of course you can still bring in a spreadsheet or other file on a onetime basis by using the import function. *Freelance Plus* 3.0 now imports the following file formats: .WK?, .WR1, .WRK, .PIC, *dBASE*, SYLK, TIFF, .CHT and .DRW (propri-

(continued on next page)

HANDS-ON INDEX

Freelance Plus

(continued from page 33)

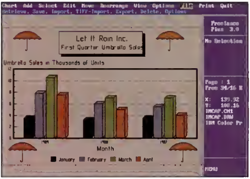


Chart Add Select Edit Move Rearrange View Options FILE Print Quit
Retrieve, Save, Import, TIFF-Import, Export, Delete, Options
Freelance Plus 3.0
No Selection
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From 34/16 E
X: 139.92
Y: 100.16
INCAP.CH1
INCAP.DRW
IBM Color Pr
MENU
Let It Rain Inc.
First Quarter Umbrella Sales
Umbrella Sales in Thousands of Units
12
10
8
6
4
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1988
1988
1987
Month
January
February
March
April

Freelance Plus *3.0's improved device-specific print preview displays exactly what your chart will look like with the output device you've chosen.*

etary file formats), graphics metafiles (.CGM and .GMF), and ASCII. It can export PostScript .EPS, HPGL, .CGM, TIFF, .PIC, and .GX2 files.

Other improvements in the charting arena include four new types of charts—high-low-close, bar-line, area, and table—and increased customizability. Style elements—like so-called 3-D effects, legend placement, and drop-shadows—can now be controlled from within the fill-in-the-blanks chart form, instead of by editing them manually.

New presentation features include Portfolio and Screen Show. The Portfolio lets you group and order up to 100 files for printing, previewing, and storing graphics. You can move easily between the Portfolio list and the Charts and Drawings menu, and you can turn your Portfolio list into a Screen Show, which simulates a slide show on-screen.

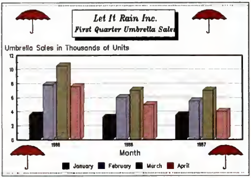
The Screen Show comes with snazzy special effects, like fade, wipe, scroll, and spiral. Although you can control the timing of your show, some of the special effects—like drip—take up to 2½ minutes to execute on an 8-MHz AT.

Lotus has also beefed up the symbol library, adding 100 new symbols and maps and 100 new templates for text-chart backdrops. Combined with the substantial library of past versions, the additions make it easy for even the artistically inept to create attractive charts. My only complaint concerns the frustrating process of finding and retrieving the symbol you want. You must plow through several layers of menus simply to view a symbol.

All these features make *Freelance Plus* 3.0 a very powerful package. Unfortunately, mastering the package's more-sophisticated features requires a lengthy and sometimes tedious learning process. If you need to churn out a few charts and don't have time to learn all the features, you can stick to Lotus's default settings, which do produce attractive charts. But be warned: if you start customizing your charts or exploring some of the freehand drawing commands, you may be in over your head, unless you're a sophisticated graphics user.

The *Freelance Plus* 3.0 user interface doesn't make matters much better. While consistent with that of past versions, the menu structure seems convoluted at times, leaving you to wonder where that one feature is hiding.

Despite its few shortcomings, Lotus's *Freelance Plus* 3.0 rates as a truly impressive package. Its expanded data import-export capabilities, device-specific page preview, and on-screen slide show make this latest version a powerful, comprehensive package for business graphics users.



Freelance Plus *3.0's default settings for chart designs allow novices to make attractive charts without having to master complex features.*

FACT FILE

Freelance Plus, Version 3.0
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-4409

List Price: $495; upgrade from *Freelance Plus*, Version 2.*x*, $100 (free if purchased after September 6); upgrade from *Freelance*, $150.

Requires: 640K RAM, graphics adapter, DOS 2.1 or later.

In Short: New features—such as an on-screen slide show, a device-specific page preview, and dynamic data linking to spreadsheets—make *Freelance Plus* 3.0 a powerful, comprehensive business graphics package. Not copy protected.

CIRCLE 432 ON READER SERVICE CARD

Microsoft Word

(continued from page 33)

IBM 8514/A and 66-line Genius screens, as well as for Hercules, CGA, EGA, MCGA, VGA, AT&T, and Toshiba. VGA and EGA users will have more display options to choose from (including up to 60 lines in graphics mode on the VGA), and all screen modes will be menu selectable.

Any user with a graphics adapter will be able to take advantage of *Word* 5.0's Page Preview command. The resulting display is noneditable, but it goes a long way toward taking the headaches out of working with multicolumn layouts. And, speaking of layouts, a new Show Layout command lets users see and edit both snaking and side-by-side columns as they'll appear on the printed page.

Word's Link command has been beefed up substantially. In Version 4.0, Link could be used to pull in data from a Lotus or Microsoft spreadsheet. Version 5.0 turns Link into a true "frame" command, allowing users to incorporate graphics, spreadsheet data, or other *Word* documents as layout islands within a current document. The resulting frames can remain "in line"—so that editing changes move the frames as they would any ordinary text block—or can be positioned "absolutely" at the top, bottom, or middle of a page or column, or at any specified distance from the margins or the edge of the paper.

Word 5.0 links to graphics images in .PCX, TIFF, .PIC, Windows Clipboard (bit-mapped images only), HPGL, and PostScript formats. You can scale and crop graphics within Version 5.0.

For linking to external text, *Word* 5.0 includes a new "bookmark" feature. A bookmark is a named block in a *Word* document—analogous to a named range in a spreadsheet. Besides allowing you to link to a particular named section of a *Word* document, bookmarks serve two other purposes: they give you greater flexibility in jumping from one section of a document to another, and they provide a mechanism for automatic cross-referencing. With bookmarks, you can now write a reference in the form of "see page [blat]" and let *Word* 5.0 resolve [blat] at print time.

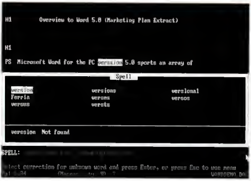
One of the frustrations of working with *Word* has been the program's inability to distinguish typefaces on-screen. You could tell italic from roman, for example, but not Courier from Times Roman. *Word* 5.0 offers a half-adequate improvement: while working in text mode, you can assign different on-screen colors to a variety of point-size ranges. Now, if you accidentally switch from your standard 12-point font to some 5-point creature, you may catch your error via color feedback. Unfortunately, the program still makes no visual distinction between, say, 12-point Courier and 12-point Times Roman.

Finally, in the sort-of publishing area, *Word* 5.0 offers snazzy new boxing and shading options. You can put massively thick borders around text or graphics and can specify any degree of shading from 1 to 100 percent (provided your printer supports the IBM Extended Character Set).

Word 5.0 also adds a number of features designed to bolster group productivity, including a document annotation feature that facilitates internal document review. Like footnotes, annotations appear in a separate window and can be printed at the bottom of pages or the end of a document, but they can also be marked with the reviewer's initials and the date and time. A macro included with the package automatically gathers annotations from many documents and compiles them into a single file, organized by page number and position within the various documents.

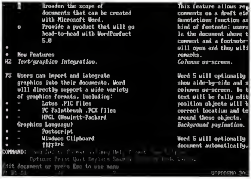
The document-management aspect of *Word* has been improved somewhat, now allowing users to copy, archive, and delete files singly or in groups from within the program. The Document-retrieval command now allows you to navigate directories and sort files in a variety of ways.

Word 5.0 includes extensive changes that, for the most part, resolve annoying failings in prior versions.



```
H1        Overview to Word 5.0 (Marketing Plan Extract)


H1

PS  Microsoft Word for the PC version 5.0 sports an array of
                                  Spell

 version              versions              versional
 Ferria               verses                versos
 versus               versts


 version  Not found

SPELL:

 lect correction for unknown word and press Enter, or press Esc to use menu
                                                                  WORDDEMO.DO
```

Word *5.0 fully integrates the spelling checker, which now occupies only a small window on the screen.*



```
             Broaden the scope of                      This feature allows re
             documents that can be created             comments on a draft ele
             with Microsoft Word.                      Annotations function as
    o        Provide a product that will go            kind of footnote: users
             head-to-head with WordPerfect             in the document where t
             5.0                                       comment and a footnote-
 *                                                     will open and they will
 *   New Features                                      remarks.
H2   Text/graphics integration.                        Columns on-screen.

PS   Users can import and integrate                    Word 5 will optionally
     graphics into their documents. Word               show side-by-side and s
     will directly support a wide variety              columns on-screen. In t
     of graphics formats, including:                   text will be fully edit
 *   -       Lotus .PIC files                          position objects will b
 *   -       PC Paintbrush .PCX files                  correct location and te
 *   -       HPGL (Hewlett-Packard                     around these objects.
     Graphics Language)                                Background pagination.
 *   -       Postscript
 *   -       Windows Clipboard                         Word 5 will optionally
 *   -       TIFF                                      document automatically.
COMMAND:
       Options Print Quit Replace Search
Edit document or press Esc to use menu
                                                                  WORDDEMO.DOC
```

You can display and edit text in multicolumn layouts in Word *5.0. For faster performance, you can edit with one column visible and check the layout via print preview.*

Word finally allows the mixing of different column layouts on a common page. It used to take a clumsy workaround to do something as ordinary as putting a banner head across two columns of text.

Tab setting in *Word* 5.0 is vastly improved. You can now work directly on the ruler with the keyboard. More important, like most other full-featured word processors, *Word* now shows you the effect of tab-stop changes before you return from command mode to the document. In addition, the ruler itself changes to reflect the character width of your current font.

Users can now opt to have documents repaginated in the background as they work. Earlier versions showed page breaks only as they appeared on the last printout, until the user explicitly issued a repaginate command.

Word 5.0 offers optional auto-save. You can specify the time interval between saves, and you can also choose to confirm each save before it's carried out.

Version 5.0 also adds a three-way case toggle command that cycles selected text through all caps, initial caps, and all lowercase. Unlike the earlier version's caps and small caps options (on the Format Character menu), this command actually alters the affected text, not just its appearance.

The spelling checker finally appears to be integrated with the program. This aspect of *Word* started out life as a separate DOS utility. By Version 4.0, it had progressed to being easily invoked via the Library command, but it still claimed its own full screen, reset the mouse position, and had a nasty way of ignoring your screen color preferences. Now it pops up unobtrusively in a window at the bottom of the screen. The spelling checker and the print routine still disagree on *Word* counts, however.

Many a user of earlier versions has been driven to the brink of insanity by *Word*'s positioning of running headers and footers relative to the left edge of the paper instead of the left edge of text. That idiosyncrasy has finally been rectified; users now have a choice.

File-export options now include .RTF and plain ASCII with intraparagraph carriage returns. The ASCII-with-returns option is useful for file communications, but *Word* still insists on preserving form-feed codes in this purportedly unformatted file structure.

Finally, the macro language has been bolstered with a variety of new features, including array variables, variables embedded in prompts, and the ability to detect and respond to low-memory and SAVE warning conditions.

All in all, *Word* 5.0 rates as a major and worthwhile upgrade—and as great news for the growing community of *Word* users. Whether the new features will be enough to close the gap between *Word* and *WordPerfect* remains to be seen.

PC MAGAZINE FACT FILE

Microsoft Word,
Version 5.0
Microsoft Corp.
16011 NE 36th Way
P.O. Box 97017
Redmond, WA 98073
(800) 426-9400
(206) 882-8080
List Price: $450; Node Pack, $195; upgrade, $75.
Requires: 512K RAM, DOS 2.0 or later.
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Not copy protected.

CIRCLE **431** ON READER SERVICE CARD

Best Buy Ever? $1,995 20-MHz 386 With Monitor, Hard Disk, 1MB RAM

HANDS ON

BY WINN L. ROSCH

I don't know how it's doing it, or why, but Micro 1 is bursting the biggest barrier to buying an 80386-based computer: price. A mere $1,995 buys you the Micro 1 Power 386-20— not just a system board in a case, but an entire computer system complete with hard disk and display.

It's not just cheaper than any other 386 on the market. It's cheaper than any 386SX, the IBM PS/2 Model 30 286, or even an equivalent scratch-built computer. The Power 386-20 is priced lower than you might pay for the parts from which it is made—possibly even less than a 20-MHz 80386-based system board alone.

Price is the only remarkable thing about the Power 386-20. Mechanically it resembles a conventional AT-compatible: big, square case, three half-height drive bays with front-panel access, and one full-height internal drive bay. Inside, a 285-watt power supply sits in the right-rear corner, and the system board fills the bottom of the left side of the chassis with five 16-bit and three 8-bit expansion slots.

The system's 80386 microprocessor operates at 20 MHz. A socket for the optional 80287 numeric coprocessor hides under the hard disk bay. The Power 386-20 is compatible with the 80387 coprocessor only through use of an optional daughterboard.

The only identifying marks on the system board of the Power 386-20 are the name Precision and some Oriental script. (Precision is a Japanese board maker.) The BIOS, copyrighted by American Megatrends, features built-in setup and diagnostics routines.

The system board accommodates the full 8-chip Chips and Technologies 80386 chip set and sockets for eight 256K or 1MB SIP (single in-line package) memory modules, allowing a maximum of 8MB of 32-bit memory. Four 256K modules rated at 100-nanoseconds provide the Power 386-20 with its standard 1MB RAM. The Power 386-20 supports ROM shadowing in the RAM beyond the DOS 640K.

An unlabeled video adapter delivers monochrome text and Hercules-compatible graphics on a 12-inch Samsung monitor. The standard parallel port of the Power 386-20 is built into the display adapter. The system ships with a 101-key Keytronic keyboard.

Either a Teac 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive comes bolted into the upper-right drive bay. The included floppy-and-hard disk controller is a Scientific Micro Systems OMTI 8240 that uses an ST506 interface and supports 1:1 sector interleaving on the hard disk. Micro 1's choice for its standard hard disk is a Seagate 138 that provides 30MB of formatted capacity. The evaluation unit was equipped with a Toshiba 45MB drive, a $235 upgrade.

System performance is outstanding for the price level of the Power 386-20 but middle-of-the-pack for 20-MHz 80386-based PCs. Its memory is simply interleaved and does not benefit from caching or other exotic technologies.

All the components that make up the Power 386-20 rank as first rate, but the construction quality of our evaluation unit was mediocre. While the chassis was solidly put together, the system board was improperly mounted, resulting in discernible curvature across its width. The front-panel reset button was not connected nor was the hard disk activity indicator. The yellow turbo-mode indicator glowed constantly, brightening somewhat when the hard disk was active.

All of these problems can be quickly solved with a little tinkering, and that's the bottom line. If you're willing to put up with a little extra work (and have the knowledge to do it), the Micro 1 Power 386-20 rates as the best buy around.

FACT FILE

Micro 1 Power 386-20
Micro 1
557 Howard St.
San Francisco, CA 94105
(800) 338-4061
(415) 974-5439

List Price: $1,995 (includes system, keyboard, monochrome display and adapter, floppy disk drive, and 30MB hard disk).

Requires: DOS 3.0 or later.

In Short: A mediocre 20-MHz 386 machine at a phenomenally low price.

CIRCLE 445 ON READER SERVICE CARD

Micro 1 Power 386-20 vs. Compaq Deskpro 386/20

PC LABS

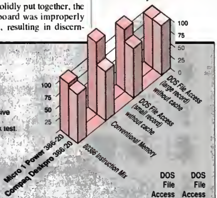
The Micro 1 Power 386-20 stands up admirably against the three times more expensive Compaq Deskpro 386/20. A quicker hard disk than the one provided would lessen the throughput differences that appear in the DOS File Access (small record) benchmark test.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.



Performance Times
(Times given in seconds)

	80386 Instruction Mix	Conventional Memory	DOS File Access (small record) without cache	DOS File Access (large record) without cache
Micro 1 Power 386-20	3.13	0.59	70.65	9.30
Compaq Deskpro 386/20	2.91	0.41	56.80	9.40

Glyphix

Headroom One-Ups Software Carousel With Memory-Management Innovations

PC HANDS ON

BY EDWARD MENDELSON

Calling *Headroom* a memory manager is like calling Houdini a handcuff manager.

Helix Software's $95 memory manipulator performs more death-defying escapes from DOS's 640K straitjacket than any other program available—and *Headroom* doesn't need anything more than a lowly 8088 to work its magic.

While you work in your word processor, *Headroom* lets you press a key to switch instantly to a spreadsheet, and then another key to switch to a database, and then another key to switch to a graphics program. Each program can have its own set of associated TSRs, or you can have TSRs that work with all applications. Each time you jump from one application to another, *Headroom* stores the unused program and its TSRs to expanded or extended memory or to disk. In effect, you can have megabytes of applications available at a keystroke.

Users of SoftLogic Solutions' *Software Carousel* have enjoyed similar functions for years. But *Headroom* adds new dimensions for swapping both applications and TSRs.

Headroom lets you pop up a TSR over a graphics program by storing the graphics screen and switching to text mode when you want the TSR. The graphics screen returns afterward. *Headroom* can even swap *Microsoft Windows* out of memory.

Better still, the program stows TSRs outside of DOS memory, swapping them into DOS when needed. Although this function is available with other utilities, nothing does it with *Headroom*'s panache.

Unlike other TSR managers, *Headroom* does not need to reserve a huge chunk of memory in DOS equivalent to the largest of your TSRs. It knows how to claim DOS memory when needed, and only when needed. It can be set to swap in a screen-capture utility when you press PrtSc. It can swap in a print spooler whenever an application sends data to the printer. It can swap in a screen blanker when you haven't touched the keyboard for a few minutes. Or it can swap in a TSR communications program when it detects a character at either serial port.

With careful installation (generally requiring a phone call to tech support), you can even swap complex multifile TSRs like *Lotus Express* in and out of memory at a specified time. And *Headroom* knows that some applications can't tolerate multiple hotkeys, so you can turn them off at any time.

Memory-management programs are inevitably precarious to work with. *Headroom*, though remarkably robust for so new a program, can still be pushed to the breaking point without your trying very hard. Helix warns that you should swap applications only at "safe" times and that all data should be saved before you jump to another program.

Headroom requires 52K of RAM compared with *Software Carousel*'s 32K, and *Headroom* is less mature and reliable. But the package accomplishes feats that *Carousel* doesn't even attempt. If you're weary of grappling with DOS's memory-handling limitations, this is one magic act you won't want to miss. PC

PC MAGAZINE FACT FILE

Headroom
Helix Software
83-65 Daniels St.
Briarwood, NY 11435
(718) 262-8787
List Price: $95
Requires: 128K RAM, DOS 2.0 or later. Not copy protected.

CIRCLE **450** ON READER SERVICE CARD

NEC CD-ROM Drive Works with PCs, PS/2s, Macs

PC HANDS ON

BY LORI GRUNIN

NEC is hoping to establish itself among the small group of CD-ROM drive makers with its $999 Intersect CDR-77—an external, SCSI-based drive.

To use the drive you must also purchase one of NEC's four $199 SCSI Interface Kits, which include device drivers and Microsoft's CD-ROM Extensions, as well as a SCSI adapter for some machines. Equipped with the appropriate kit, the drive works with a PC, PS/2, NEC MultiSpeed, or Macintosh. The CDR-77 reads High Sierra, ISO 9660, and Macintosh HFS file formats.

Installing the CDR-77 is easy. Slip the SCSI adapter into any full- or half-size slot, connect the cable from the drive to the port, plug the terminating resistor into a connector in the rear of the drive, and plug in the power cable.

A configuration program and brief manual guide you through DIP-switch adjustments if the CDR-77 clashes with another peripheral.

The Interface Kit comes with software that installs the drivers and updates your CONFIG.SYS and AUTOEXEC.BAT. The CD-ROM extensions can be configured to use expanded memory and a specified number of buffers for caching, but the installation program doesn't ask you for your desired defaults. You must later edit AUTOEXEC.BAT to take advantage of these options.

You slide CDs into a plastic caddy that you then insert into the drive. With an access time of approximately 500 milliseconds, the drive falls at the faster side of its competition. While not nearly as fast as a hard disk, it certainly isn't irritatingly sluggish on an 8-MHz AT.

The total cost of the CDR-77 matches that of similar drives. NEC, like other vendors, throws in audio capability to ease the pain of the high price. But, at the time of this review, the software necessary to play audio CDs was not yet ready for release—a frustrating omission given the dearth of software for this purpose.

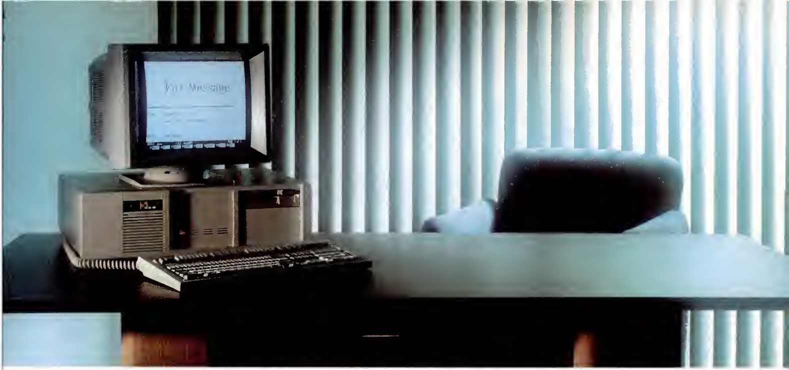
The difficult decision is whether or not to buy a CD-ROM drive. If you are as yet undecided, the NEC offering won't send you dashing to your nearest retailer. But if you are planning to buy, the NEC is as good a choice as any. PC

Photograph, Thom O'Connor

PC MAGAZINE FACT FILE

NEC Intersect CDR-77
NEC Home Electronics
(USA) Inc.
1255 Michael Dr.
Wood Dale, IL 60191
(312) 860-9500
List Price: $999; SCSI Interface Kit, $199.
Requires: 640K RAM recommended, DOS 3.1 or later.

CIRCLE **449** ON READER SERVICE CARD



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CIRCLE 135 ON READER SERVICE CARD

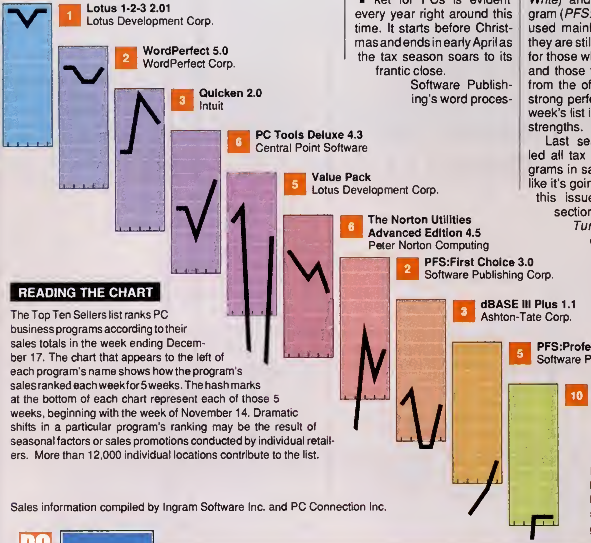
PC MAGAZINE PIPELINE

TOP TEN SELLERS — A 5-Week History

The so-called home market for PCs is evident every year right around this time. It starts before Christmas and ends in early April as the tax season soars to its frantic close.

Software Publishing's word processor (*PFS:Professional Write*) and integrated program (*PFS:First Choice*) are used mainly in offices, but they are still popular choices for those who work at home and those who bring home from the office. Their very strong performances in this week's list is a result of both strengths.

Last season, *TurboTax* led all tax preparation programs in sales, and it looks like it's going to repeat. See this issue's After Hours section for a review of *TurboTax* and its competitors.



1 **Lotus 1-2-3 2.01**
Lotus Development Corp.

2 **WordPerfect 5.0**
WordPerfect Corp.

3 **Quicken 2.0**
Intuit

6 **PC Tools Deluxe 4.3**
Central Point Software

5 **Value Pack**
Lotus Development Corp.

6 **The Norton Utilities Advanced Edition 4.5**
Peter Norton Computing

2 **PFS:First Choice 3.0**
Software Publishing Corp.

3 **dBASE III Plus 1.1**
Ashton-Tate Corp.

5 **PFS:Professional Write 2.0**
Software Publishing Corp.

10 **TurboTax '88**
ChipSoft Inc.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending December 17. The chart that appears to the left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of November 14. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

Sales information compiled by Ingram Software Inc. and PC Connection Inc.

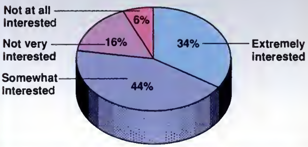
Rankings are based on net sales by unit; returns are subtracted from gross sales.

PC MAGNET SURVEY

These questions were posted on PC MagNet soon after *dBASE IV* shipped and tested the interest in moving to SQL servers, given the strong investment most *PC Magazine* readers now have in *dBASE* applications.

Considering the strong interest in new features shown by responses to the last question, Ashton-Tate has to be worried that sales of *dBASE IV* are not stronger; the long-awaited upgrade made it into the Top Ten Sellers list the week after it shipped but dropped out soon afterwards.

What is your interest in providing *dBASE* users access to a multiuser SQL server?



APPLE TRIES NEW SEDUCTION OF DOS USERS

IBM and other PC-compatible makers have made precious few concessions to the growing popularity of the Macintosh, but Apple suffers from no such tunnel vision. The newest upgrade in the Mac line packs a 3 ½-inch disk that can read disks written in DOS PCs and comes with a program that emulates the DOS environment.

The new Mac (which had not been officially named at the time of our sneak preview) looks like the Mac SE but is faster than a Mac II, thanks to its Motorola 68030 processor. It realizes John Sculley's long-standing dream of easy file sharing between Macs and PCs.

The magic comes from a new program called *SoftPC* by Insignia Solutions. The software emulates an Intel 80286 and lets Mac users set aside a DOS partition on their Mac hard disk. Applications perform at a level roughly equivalent to an IBM PC AT on programs like *Ventura Publisher*, Microsoft's *Flight Simulator*, and *Lotus 1-2-3*. An early version of the new Mac scored 1.9 on Norton's SI.

This may remind you of the empty promise made when the Mac II was introduced in early 1987. A coprocessor board developed by AST was supposed to make the Mac II a beefy switch-hitter; it was an expensive failure thanks to abysmal screen handling and a mandatory external floppy disk drive. It was cheaper to simply buy an extra AT and network the two machines.

This time, Apple's hopes are tied to a much more promising emulator. *SoftPC* has been running since 1986 on Sun-3 systems and can emulate the DOS environment on a DEC VAX, HP Spectrum, or Mac II.

SoftPC has been running since 1986 on Sun-3 systems and can emulate the DOS environment on a DEC VAX, HP Spectrum, or Mac II.

SoftPC is an application program that emulates all aspects of the PC, providing the full 8088 instruction set and BIOS calls. It runs in a window on the Mac. MS-DOS is installed underneath it, and Mac's FileFinder sees the DOS disk as one huge file.

Apple will press the compatibility issue even further by lining up network card manufacturers for this machine very early.

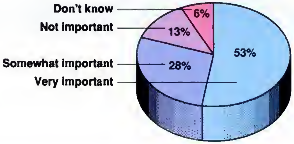
Ironically, Apple's top management had wanted to make the Mac more DOS compatible right from its earliest days in 1984 but they were overruled by Steve Jobs and the creative team.

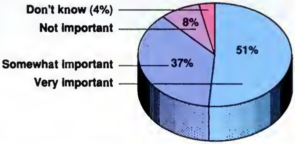
Running PC software on an alien machine may not be important to you, but it is to Apple. With sales now running at $5 billion annually, the company has a lot of momentum and is looking for room to grow. The need to move files between a Mac and a PC is such an easily solved problem that, in the great scheme of things, it's trivial. But in the psychological trenches where salesmen work, PC-Mac file sharing is a grand notion.

Signposts

With the installed base of DOS-compatible PCs now well past 16 million in the U.S., this shouldn't come as any surprise, but somehow it does. Z-Soft has now shipped more than 1 million copies of *PC Paintbrush*. That's partly the reward of longevity (it first shipped in October 1985, making it the first PC paint program), and partly a side effect of the continued growth of *Microsoft Windows*. . . Is the world ready for software from Donald Trump? The first tie-in between a software game and the casino owner was recently hatched. *Trump's Castle*, the game, is not unlike Trump's other deals: a small software publisher (Intracorp) did all the work, and Trump's name goes on the box. The $34.95 program includes six casino games (blackjack, craps, keno, and so on) and coupons to lure you into Trump's Atlantic City casino. . . Lucasfilm, the movie production company founded by George Lucas, has been gearing up its PC software games division with little success so far. It sells several programs, including *Maniac Mansion*, which was a fairly lackluster mystery-adventure (see After Hours, *PC Magazine*, October 31, 1988). In an effort to bring more "intergalactic" Hollywood technology to the PC, the games division is being merged with Industrial Light & Magic (Lucasfilm's team of masters of illusion that created the special effects for *E.T.* and *Who Framed Roger Rabbit?*). The first software project is a movie tie-in with *Indiana Jones and the Last Crusade*, a motion picture slated to open in May.

—Gus Venditto





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CIRCLE 260 ON READER SERVICE CARD

SOTA 286i Accelerator for XTs Runs at 12.5 MHz, Works in 8086 Machines

PC HANDS ON

BY JONATHAN MATZKIN

The SOTA 286i from SOTA Technology is designed to meet the upgrade needs of PC and XT users—whether their machines are 8088- or 8086-based. This half card accelerator uses an 80286 processor running at 12.5 MHz to rev up the performance of most PCs, XTs, or clones. In addition to its broad hardware compatibility, the SOTA 286i appears to be compatible with a wide range of software. In the past, few accelerators have worked in both 8088 and 8086 machines, and some have balked at running some commonly used software.

The $499 accelerator card offers a 16K static RAM cache, expandable to 64K, and connectors for several other options. A $149 floppy disk drive controller on a daughtercard lets you add up to four floppy disk drives of any density and has serial and parallel ports. There are also memory expansion and cache expansion options.

As is the case with many other accelerator cards, installation of the SOTA 286i is not for the faint of heart. You begin by removing the 8088 or 8086 from your PC's motherboard. That operation is fraught with possibilities of damaging the processor. Once you have successfully negotiated this tricky obstacle, you relocate the 8088/86 to the SOTA 286i.

There are also several jumpers that have to be set on the card, according to whether you are using the accelerator in an 8088- or an 8086-based machine. You must also reposition another chip in the 286i to suit the type of machine you are speeding up.

Once the hardware installation is complete, software setup is comparatively simple. You just write a call to SOTA's device driver into your CONFIG.SYS file that enables the 16K static RAM cache, which delivers most of the noticeable speed increase. If the cache isn't enabled, then the 80286 has to slow down to match the PC's or XT's slow system memory, and the results are hardly worth the effort.

I tried the SOTA 286i in an 8088 machine (an ancient XT) and in an 8086-based Victor VPC II. When properly installed, it worked fine in both machines. After installing it in the Victor, I successfully installed and ran Microsoft's *Flight Simulator*, which has developed into something of a standard for compatibility testing. I also tried *Lotus 1-2-3*, XyQuest's *XyWrite*, and Quarterdeck Office Systems' *DESQview* without incident. *Fastback Plus* from Fifth Generation Systems, which uses hardware DMA, also ran fine.

Benchmark-Test Results

The processor speed benchmark tests for the XT with the SOTA 286i installed show a marked increase in performance. The Do-Nothing Loop, Integer Add Loop, and Prime Number Sieve benchmark tests all ran at about twice the speed expected of an 8-MHz IBM PC AT. Other tests showed less-dramatic increases. Only the 128K NOP Loop test produced seemingly anomalous results.

This test actually produced slower results, by a small margin, than would be expected from an unmodified XT. The reason is simple—the test effectively disables the SOTA 286i's RAM cache, leaving the 80286 to work with the XT's plodding system RAM. The additional wait states necessary to make this work dissipate any speed improvement, for the same reason that booting the 286i without activating its cache delivers performance negligibly faster than a plain XT.

No upgrade, no matter how effective, will completely overcome the limits of an older technology. The SOTA 286i does deliver a noticeable performance boost, however, and the board seems to be exceptionally compatible, both on the hardware and software levels. It's a good choice for any PC or XT owner who wants 80286 power and who doesn't get queasy at the thought of performing a little motherboard surgery. PC

PC FACT FILE

SOTA 286i
SOTA Technology Inc.
657 N. Pastoria Ave.
Sunnyvale, CA 94086
(408) 245-3366
List Price: $499; floppy disk controller on daughtercard, $149.
Requires: 8086- or 8088-based PC or compatible.

CIRCLE **446** ON READER SERVICE CARD

Benchmark Tests: SOTA 286i vs. 8-MHz IBM PC AT and 4.77-MHz IBM PC-XT

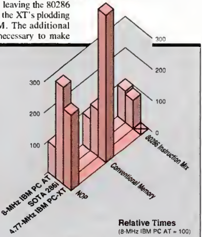
PC LABS

The NOP benchmark test, in particular, illustrates the one real shortcoming of the SOTA 286i. Because it lacks on-board memory, the SOTA 286i depends on a 16K static RAM cache to compensate for the slow native memory of the IBM PC-XT. Otherwise, its performance rivals that of an 8-MHz IBM PC AT.

Performance Times
(Times given in seconds)

	NOP	Conventional Memory	80286 Instruction Mix
8-MHz IBM PC AT	4.19	1.27	8.82
SOTA 286i	13.07	1.87	7.96
4.77-MHz IBM PC-XT	10.16	5.99	N/A

N/A—Not applicable not 286-based



Relative Times
(8-MHz IBM PC AT = 100)

The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **80286 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80286 instruction code. These instructions are a subset of the total processor instruction set.

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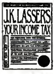

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CIRCLE 254 ON READER SERVICE CARD

Fastback Plus 2.01: No More Backup Excuses

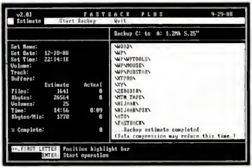
PC HANDS ON

BY EDWARD MENDELSON

The best backup program is the one that gives you the fewest excuses not to use it. Fifth Generation Systems' $189 *Fastback Plus*, Version 2.01, pulls out the rug from under almost every antibackup excuse you can imagine.

Do your backups take too much time? *Fastback Plus* can back up 10MB of a real-world hard disk to a single 1.2MB drive in 4 minutes. Do you tell yourself you'd back up regularly if you could automate the tedious process of selecting files? *Fastback Plus* lets you record and play back all the keystrokes needed for the most complex and selective backup. Too much trouble even to find the exact files you need to back up or restore? *Fastback Plus* alphabetizes directories and files on its selection screens and backup disks.

Maybe you're willing to back up your own files, but you say backups are too difficult for your coworkers. The macro language in *Fastback Plus* lets you customize messages to remind even the most unsophisticated user to insert the right disk at the right time. Or maybe you had a bad experience with a backup program that gave up when you fed it a defective disk. *Fastback Plus* recovers gracefully from this and any other stumbling block.



```
v2.01                 F A S T B A C K   P L U S                9-29-88
  Estimate       Start Backup      Quit

                                 Backup C: to  A: 1.2Mb 5.25"
Set Name:                        \WORD\
Set Date:   12-10-88             \WP\
Set Time:   22:14:18             \WP\WPTOOLS\
Volume:                          \WP\MOUSE\
Track:                           \WP\PUBSTAR\
Buffers:                         \XTPRO\
              Estimate    Actual \XY\
Files:            1641         0 \ZERODIR\
Kbytes:          26564         0 \MTM_TAPE\
Volumes:            25           \HIJAAK\
Time:            14:56      0:09 \HIJAAK\PIX\
Kbytes/Min:       1778         0 \ATO\
                                 \FASTBACK\
% Complete:                    0 ...Backup estimate completed.
                                 (Data compression may reduce this time.)

 ←→,FIRST LETTER  Position highlight bar
           ENTER  Start operation
```

Fastback Plus *gives a conservative estimate of time and disks required for a backup.*

Fastback Plus doesn't even allow you the excuse that you don't like its interface. The pull-down menu system comes in three flavors for beginning, experienced, and advanced users, each with a different range of options. If you don't like pull-down menus, you can choose question-and-answer menus. If you don't like menus at all, you can do everything from the DOS command line.

When you restore files, *Fastback Plus* prompts you for the exact disks and warns you if the hard disk doesn't have room for the files. A minor weakness in the program is its lack of a quick name-search function to find a filename to back up or restore when you don't know its directory.

There's only one catch to the high-speed backups, reliable restores, and unparalleled range of options and conveniences you get from *Fastback Plus*. If you fail to back up your disk and lose your precious data as a result, you're the only one to blame. PC

PC MAGAZINE FACT FILE

Fastback Plus,
Version 2.01
Fifth Generation Systems Inc.
11200 Industriplex Blvd.
Baton Rouge, LA 70809-4112
(800) 873-4384
(504) 291-7221
List Price: $189
Requires: 330K RAM, DOS 2.1 or later. Not copy protected.

CIRCLE 431 ON READER SERVICE CARD

MicroStation PC Adds Menus, EMS Support

PC HANDS ON

BY JEFF PROSISE

If you're involved in the corporate CADD enviroment, chances are you've heard of Intergraph's VAX-based *Intergraph Graphics Design Software* (*IGDS*), one of the leaders in mainframe and minicomputer CADD. *MicroStation PC* is Intergraph's downsized version of *IGDS* for PCs.

The latest release, Version 3.0.0, features a number of enhancements that make *MicroStation* a faster, more flexible product (for an overview of the previous version, see "High-End CADD: Expanding to New Dimensions," *PC Magazine*, August 1988).

Foremost among the new features is support for sidebar menus. Past incarnations of *MicroStation* were notable for the stark screens they presented, devoid of any *AutoCAD*-like menus suitable for selecting commands with a mouse. Sidebar menus, which can be placed horizontally across the top or bottom of the screen or vertically along the left or right, provide quick on-screen access to *MicroStation* commands.

Version 3.0.0 also adds support for up to 8MB of Lotus/Intel/Microsoft expanded memory to cache design files and increase drawing speed. If *MicroStation* senses expanded memory at start-up, it will automatically use what's available to reduce time-consuming disk accesses. Screen updates and operations involving cached drawing entities can be sped up five to ten times.

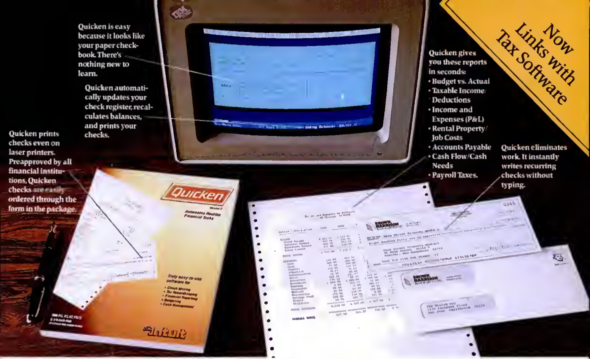
Other new features include a suite of array commands for generating rectangular or polar arrays of elements, a chamfer command, and support for B-spline curves. 3-D views can now be shown in perspective. Cursor coordinates can be displayed in real time. Snapping can be directed to the intersection of two elements, and fillets can now be applied between two arcs or circles. Previous versions would only generate fillets between linear elements.

If you're not already tied to *IGDS*, there is little compelling reason to buy *MicroStation PC*. Other microcomputer-based CADD packages offer as many features and are easier to master. But if *IGDS* is your game, give *MicroStation PC* a close look. No other package can offer you file and command-level compatibility with mainstream *IGDS* systems the way *MicroStation PC* can. PC

PC MAGAZINE FACT FILE

MicroStation PC,
Version 3.0.0
Intergraph Corp.
One Madison Industrial Park
Huntsville, AL 35807-4201
(800) 345-0218
(within Alabama)
(800) 345-4856
(outside Alabama)
List Price: $3,300
Requires: 640K RAM, math coprocessor, hard disk, DOS 3.0 or later. Copy protected via parallel port key.

CIRCLE 432 ON READER SERVICE CARD


Now Links with Tax Software
Quicken is easy because it looks like your paper checkbook. There's nothing new to learn.
Quicken automatically updates your check register, recalculates balances, and prints your checks.
Quicken prints checks even on laser printers. Preapproved by all financial institutions, Quicken checks are easily ordered through the form in the package.
Quicken gives you these reports in seconds:
• Budget vs. Actual
• Taxable Income/ Deductions
• Income and Expenses (P&L)
• Rental Property/ Job Costs
• Accounts Payable
• Cash Flow/Cash Needs
• Payroll Taxes.
Quicken eliminates work. It instantly writes recurring checks without typing.
Quicken
Intuit

Scientific Graphs, Graph-in-the-Box Style

HANDS ON

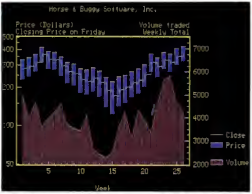
BY LORI GRUNIN

Number crunchers and devotees of New England Software's *Graph-in-the-Box* pop-up graphing package will be delighted by the company's latest addition to its graphics line. The $199.95 *Graph-in-the-Box Analytic* uses the same interface, this time to generate 15 types of *x-y* and double-*y* plots.

Analytic pops up over applications to let you capture data, which you can then massage and use to create various scatter plots, trend lines, spline curves and max-min charts. You make selections by toggling through lists or diagrams.

Ostensibly, you can also import the data in .DIF format, but a bug in that option consistently locked up both my True Blue XT and AT. Aside from entering data manually, your only other option is first to import the .DIF file with *Graph-in-the-Box* (if you have it), next save it as a chart, and then pull it into *Analytic*.

If screen capture were easier, this wouldn't be necessary. But to capture more than one screenful of data requires jumping in and out of the program—there is no way to scroll the application screen while *Analytic* is "awake." Still, unless you are trying to capture a century's worth of weekly interest rates, you shouldn't be too inconvenienced. The program ignores any text within the data range, which means that if you have monthly data, for example, you can't label observations with names of months.



Graph-in-the-Box Analytic *lets you specify linear or logarithmic scaling on any of the three axes and calculate minima and maxima for high-low-close graphs.*

The program boasts surprisingly good data-manipulation capabilities—logical and relational operators, common mathematical functions, and a random number generator, as well as procedures to calculate *n*th-order moving averages and differences, percentage growth, and class averages. You enter formulas in a one-line dialog box that you call with F3. Typing "undo" in the box will cancel any miscalculations.

The color handling could be better. You can choose from among 16 colors for each variable on an EGA system and can cycle through color combinations as you view a graph, but the program identifies colors only by number. To change any individual color you must return to the data screen, change "color 2" to "color 3," and regenerate the graph to see what color 3 is. It would be nice at the very least to see how color 3 is currently defined when you are making a choice.

Analytic comes with a batch utility that lets you create on-screen slide shows and automate printing. The program will output on most plotters and graphics-supporting dot-matrix and laser printers.

If you want a package that generates sensational graphs from as-is data, you could probably do better elsewhere. But if you love *Graph-in-the-Box* or need to transform the data before churning out nice-looking graphs, *Graph-in-the-Box Analytic* might just fill the bill.

FACT FILE

Graph-in-the-Box Analytic
New England Software Inc.
Greenwich Office Park, #3
Greenwich, CT 06831
(203) 625-0062
List Price: $199.95
Requires: 128K RAM, DOS 2.0 or later. Not copy protected.

CIRCLE **444** ON READER SERVICE CARD

Classic Programmer's Guide Gets Update

BOOK REVIEW

BY BARRY SIMON

Evangelists of portable code preach that you should leave the operating system to the compiler. But performance considerations often prompt the programmer to write directly to DOS and the BIOS. *The New Peter Norton Programmer's Guide to the IBM PC & PS/2*, an updated version of Norton's classic 1985 programmer's guide, is intended for people who do just that.

Richard Wilton, author of a highly regarded book on PC video programming, coauthored this revision with Norton.

The structure and, in portions, the content of the book are quite close to the 1985 work. For items that existed back then, the book retains most of the content of the original text. One welcome change is the use of hexadecimal format instead of decimal format for references to service numbers. The portions of the book concerning areas of great change, such as video and keyboard, have been completely rewritten. And, of course, the PS/2-specific material is all brand new.

The book maintains the lucid, informative tone of the first version. Its biggest failing lies in its limited number of code fragments and in its heavy use of BASIC in even those few. The only serious error I noted was the book's failure to note that services 5, 10, 11, and 12 of INT 16 are not supported by the original PC and XT or by early ATs.

Any serious PC programmer will want this book on his shelf along with Duncan's *Advanced MS-DOS* (Microsoft Press, ISBN 0-914845-77-2) and Armbrust & Forgeron's *Programmer's Reference Manual for IBM Personal Computers* (Dow Jones/Irwin, ISBN 0-87094-765-6). Let's just hope that this time we don't have to wait quite so long for an update.

FACT FILE

The New Peter Norton Programmer's Guide to the IBM PC & PS/2
By Peter Norton and Richard Wilton
Microsoft Press
16011 NE 36th Way
Box 97017
Redmond, WA 98073
(206) 882-8080
ISBN: 1-55615-131-4
List Price: $22.95

CIRCLE **448** ON READER SERVICE CARD

Don't drag your PC along! Take the shortcut between programs and files with Software Carousel.®

Why get dragged down by that old PC technology?

Despite the sophistication of today's PCs, there's one thing they still don't do. And that's work the way people work. Jumping from one task to another – from budgets to memos to phone calls and back.

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Here's how to make Software Carousel work for you.

Software Carousel is the amazingly easy way to switch almost instantly from WordPerfect to 1-2-3 to dBASE to DOS to whatever else you want. Or go from one file to another in the same program. All without saving or retrieving – or wasting a precious moment of your time. Or your computer's memory.

It works by creating a number of independent software slots to load your programs into. You get up to ten of these software slots, so you can load up to ten programs.

Need to crunch numbers? Hit a key and there's your spreadsheet. Need your word processor? Don't bother saving your spreadsheet file. Just whip over to your document and do your work. Snap back to your spreadsheet and it's just like you left it. It's like all your programs are "pop-ups," just a hotkey away.

Or load the same program into a few different slots, each with a different file. Now go from one to another in an instant.

Here's the best part of all.

You may have heard about some other "environment" programs that claim to do something similar to Software Carousel. But there are several important differences.

First, they make you split your memory up among the programs you want to use. Software Carousel lets you use all available memory in each and every program. It even supports expanded and extended memory.

Other environment programs work with only some software. Software Carousel works with everything. Period. It even resolves conflicts among memory resident programs.

Other software creates a working environment that's complex, unfamiliar, with cramped little windows and strange commands. Software Carousel takes minutes to set-up just the way you want it. All your software looks and acts exactly as it always did.

It's so downright useful, even IBM® recommends it.

Even as you read this page, there are tens of thousands of Software Carousel users zipping through their work without laborious and repetitive commands. And without the usual 640K limit imposed by DOS. In fact, even IBM recommends Software Carousel for use with their most popular mainframe-to-PC communications package.

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Look for Software Carousel at software dealers everywhere. Or order direct from SoftLogic Solutions by calling us toll-free. If, after thirty days, you're not satisfied that Software Carousel is the right way to get that old PC technology off your back, we'll gladly arrange for a refund of your purchase price.

Here's what people are saying about Software Carousel:

"Can't believe how well it works. Who needs 80386?"
–Ralph Evans, Attorney, Fullerton, CA

"Unlike other attempts (e.g. MS Windows, DesqView) yours works, is not fragile and does not intrude its "personality" on everything that we do."
–Colin Ralph, Ralph & Panzer, Inc., Seattle, WA

"Fantastic program. Great book. Saves me an hour a day! Thanks."
–Larry Pearsal, Rolling Hills Covenant Church, Rolling Hills Estates, CA

"Solved all my problems with resident software."
–Walter Affourtit, West Islip, NY

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#6

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- Socket for an 80387
- Accepts Weitek 1187 Chip set
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- Landmark speed test equals 33.6, Norton SI rating equals 31 6
- Large selection of Hard Disks available from 20 to 320MB in ESDI, SCSI, RLL and MFM drive configurations

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- Western Digital 2F-2H Controller
- 1 2MB Floppy Disk Drive
- AT and OS/2 Compatibility
- 220 Watt Power Supply
- Socket for Weitek, 80387 and 80287
- One 32 Bit Slot, Five 16 Bit Slots, Two 8 Bit Slots.
- Norton SI rating equals 27

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$1,095

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- AT and OS/2 Compatibility
- 220 Watt Power Supply
- Socket for 80287 Coprocessor

Model 386-4 16MHz

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- Speed selectable for 4 77/6/8/16MHz
- Clock Calendar with battery backup.
- 101 Enhanced Keyboard
- Western Digital 2F-2H Controller
- 1 2MB Floppy Disk Drive
- AT and OS/2 Compatibility.
- 220 Watt Power Supply
- Socket for 80287 (daughter card for 80387).
- One 32 Bit Slot, Five 16 Bit Slots, Two 8 Bit Slots
- Norton SI rating equals 20.5.

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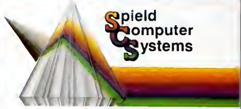

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CIRCLE 390 ON READER SERVICE CARD

NEW ON THE MARKET

by Lori Grunin

Fast File Transfer Between Your PCs

For those times when 115 kilobits per second isn't fast enough, **3X USA**'s 3X-Link16 provides background file transfer at 500 kilobits per second, and up to 1.5 megabits per second between 80386-based machines, according to the company. It can support a maximum of 16 PCs connected simultaneously.

The 3X-Link TSR software, parallel port adapter, and 12-foot cable combination provides a network link and printer output port. The software administers background disk and printer sharing and e-mail, all of which take place at the same rate of 500 kilobits per second. 3X-Link16's dual-window interface provides such pleasantries as commands to search among files, overwrite latest versions only, and move or copy subdirectories.

Additional features only a LAN manager could love include multilevel passwords and a script facility for performing repetitive LAN management tasks. The e-mail system's chat mode allows users to communicate directly via pop-up windows on their screens.

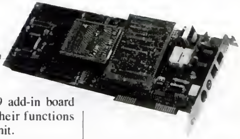
List Price: 3X-Link16, $199 for the first two stations, $139 each subsequent station. **Requires:** 384K RAM per station, a parallel port, DOS 2.0 or later. 3X USA, One Executive Dr., Fort Lee, NJ 07024; (201) 592-6874.

CIRCLE **437** ON READER SERVICE CARD

The 3X-Link16's parallel port adapter provides connections to a network and printer.

The Complete PC's Add-in Board Blends Data, Fax, Voice Mail

The Complete PC's lines of modems, fax machines, and voice-messaging boards converge in The Complete Communicator, an $899 add-in board which merges their functions into one handy unit.



The Complete Communicator's fax supports background operation

The board's 9,600-bit-per-second fax modem is Group III compatible, and it supports background sending, receiving, and printing. Faxes can be sent from within many word processing and graphics applications, and on-screen display permits zooming and scaling of images.

Voice-mail capabilities include 999 mailboxes with password protection, message forwarding, and call transfer. The 2,400-bps, Hayes-compatible data modem comes with Bitcom communications software.

The Complete Communicator can convert files from *Dr. Halo II*, *PC Paintbrush Plus*, *Microsoft Windows Paint*, and Epson FX graphics formats to fax, and can convert fax files to TIFF and all but the last.

List Price: The Complete Communicator, $899. **Requires:** 512K RAM, hard disk, standard phone line, DOS 3.1 or later. The Complete PC, 521 Cottonwood Dr., Milpitas, CA 95035; (408) 434-0145.

CIRCLE **438** ON READER SERVICE CARD

Two Inexpensive Aids For Users of dBASE

Not everyone needs multitasking capabilities—some of us just want to be able to exit a program temporarily, go about our business, then take up where we left off.

Switch It, a $39.95 utility from **Black & White International**, makes it easier for *dBASE* users to fulfill this simple dream. When invoking a memory-hogging application using *dBASE*'s RUN command, *Switch It* swaps *dBASE* out of the memory between 256K and the maximum available, and replaces it with the application. The reverse occurs upon exiting the application, and you are returned to where you left off in *dBASE*. Users can also create a menu of frequently called applications.

Switch It can save temporary files to disk or a RAMdisk and is compatible with *FoxBASE Plus*, *DBXL*, *Clipper*, *Quicksilver*, and *Eagle*, as well as *dBASE III Plus* and *IV*. Black & White also sells a $59.95 runtime version, *Switch It Runtime*, which can be distributed freely.

Memory crunches aren't the only problems *dBASE* users face: without a compiler, the program can be irritatingly slow. The $69.95 *dBOOST* uses a proprietary buffering system

(continues on page 52)

HOT PROSPECT

Lotus's Magellan Sails Through Files and Displays Popular File Formats

Lotus will soon release a $195 hard disk utility that provides file viewing and searching across directory boundaries and understands the syntax of complex queries.

Called *Magellan*, the program reads the most popular file formats, so that a query of a *dBASE* file will return a display of the database in *dBASE* format automatically; *DisplayWrite*, *Microsoft Word*, and *WordPerfect* are among the readable formats.

Magellan provides a wide range of disk-searching tools and enables you to use an entire hard disk without worrying about specific directory boundaries. An alphabetical file sort, for example, will list all files on the hard disk in every subdirectory, in the proper order.

A search for files where "John Doe talks about suing Sue Smith" lists phrases with all forms of the root "sue," including "sued," "suing," and "suit." It would also sort the files to show the strongest matches first.

Magellan, due out this winter, was written by Bill and Larry Gross, the brothers who created *Lotus HAL*.

List Price: *Magellan*, $195. **Requires:** 512K RAM; DOS 2.1 or later. Not copy protected. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; (617) 577-8500.

CIRCLE **433** ON READER SERVICE CARD

NEW ON THE MARKET

dBASE Aids

(continued from page 51)

that speeds runtime by up to 60 percent, according to its creator, **Isogon.** The TSR software will use expanded memory if available.

List Price: *Switch It*, $39.95; *Switch It Runtime*, $59.95. **Requires:** 15K RAM, DOS 2.0 or later. Not copy protected. Black & White International Inc., P.O. Box 1040, New York, NY 10024; (212) 787-6633.

CIRCLE **439** ON READER SERVICE CARD

List Price: *dBOOST*, $69.95. **Requires:** 20K RAM, DOS 2.0 or later. Not copy protected. Isogon Corp., 330 Seventh Ave., New York, NY 10001; (212) 967-2424.

CIRCLE **440** READER SERVICE CARD

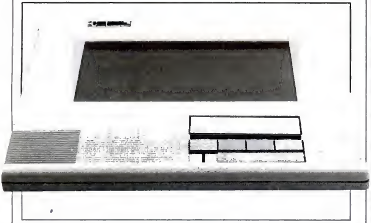
$1,499 EGA Data Display Projects 16 Different Shades of Simulated Color

Projection-panel technology must rely on simulating the EGA palette to help you share your color presentations with the world. Many projectors translate each color into a different pattern, such as dots or a grid, but **Computer Accessories'** $1,499 EGA Data Display performs this feat by mapping each of the palette's 64 colors into ones that the projector can display—different intensities of the LCD pixel colors. It supports 16 simultaneous colors and 640 by 350 resolution as well.

The EGA Data Display mounts on any overhead projector and makes use of an infrared filter that, combined with a proprietary fan and airflow system, helps forestall the appearance of heat-generated dark spots on the panel.

Brightbill-Roberts's *PC Partner* presentation software, which facilitates the production of slide shows and performs screen captures, comes bundled with the panel.

The EGA Data Display is approximately 1 by 12½ by 12 inches (HWD) and weighs 3 pounds. An optional carrying case costs $69.95.



The Computer Accessories' EGA Data Display mounts on any standard overhead projector. It does not require a special adapter or software.

List Price: EGA Data Display (Model A400SC), $1,499; carrying case, $69.95. **Requires:** EGA or CGA video port. Computer Accessories Corp., 6610 Nancy Ridge Dr., San Diego, CA 92121; (619) 457-5500, (800) 582-2580.

CIRCLE **435** ON READER SERVICE CARD

PC+Inspire Erasable Optical Drives

Although OEM versions of erasable optical drives have been available for several months, the first units are just now becoming available to end users.

The PC+Inspire from **Alphatronix**, one of a series that includes units for Sun and DEC workstations, is a 5¼-inch single- or dual-drive system that uses double-sided removable cartridges holding 650MB each.

The system can support up to seven drives, for a maximum capacity of 4,550MB. The PC+Inspire conforms to the ISO, ANSI, ECMA, and Japan Study Committee 23 standards, accepts 3M or Sony cartridges, and functions transparently with DOS. The drive has a random-access average seek rate of approximately 83 milliseconds, according to Alphatronix.

The dual-drive PC+Inspire provides 1,300MB of rewritable storage.

List Price: PC+Inspire, single-drive unit, $9,995; dual-drive unit, $14,950. **Requires:** DOS 3.1 to DOS 3.3. Alphatronix, 4900 Prospectus Dr., #1000, P.O. Box 13687, Research Triangle Park, NC 27709; (919) 544-0001, (800) 992-1770.

CIRCLE **434** ON READER SERVICE CARD

386 Motherboard/CP Turns Your Compaq Portable into an 80386

A time usually comes when even the most reluctant computer user toys with the idea of upgrading—gutting that old 8086/88 and turning it into a state-of-the-art machine. When the urge strikes Compaq Portable or Compaq Plus owners, they can replace their original 8088-based system board with **Hauppauge**'s 386 Motherboard/CP, a $1,695 replacement board running a 16-MHz 80386 processor.

The zero-wait-state board comes with 1MB of memory and updates the machine's expansion-slot configuration to one 8-bit, three 16-bit, and one 32-bit. Memory can be increased to 16MB, in 4MB increments, using Hauppauge's optional 32-bit, zero-wait-state memory card.

For another $245, users can also upgrade their floppy/hard disk controller: $1,870 buys a package of both the motherboard and controller.

Hauppauge recommends upgrading the Compaq Portable's power supply if the original is still in the machine.

List Price: 386 Motherboard/CP, $1,695; hard/floppy disk controller, $245; motherboard and controller, $1,870. **Requires:** Compaq Portable or Plus. Hauppauge Computer Works Inc., 175 Commerce Dr., Hauppauge, NY 11788; (516) 434-1600.

CIRCLE **436** ON READER SERVICE CARD

Compuclassics

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CIRCLE 205 ON READER SERVICE CARD

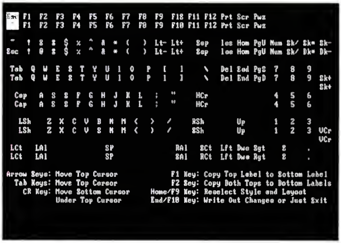
FANSI Console Speeds Screen Writes

HANDS ON

BY BARRY SIMON

FANSI Console, Version 3.0, named for fast ANSI, will speed up your screen writes and keyboard action. In my tests it increased the screen scrolling by a factor of three to six times. The $75 program also provides enhanced keyboard functions.

Because it works by replacing the code in your ANSI.SYS file and in your BIOS, *FANSI* acts only on programs that make DOS calls or BIOS calls for screen and key functions. *Microsoft Windows*, for example, comes with its own keyboard handler, so it would not receive any benefit if *FANSI* were loaded. As for *Lotus 1-2-3*, *FANSI* will accelerate its key-repeat rate, but it won't improve the spreadsheet's display performance, because *1-2-3* uses its own screen driver. *FANSI* doesn't do anything to *Microsoft Word*, but it does speed up both the key-repeat rate and the display writes in *WordPerfect*.



```
Esc F1  F2  F3  F4  F5  F6  F7  F8  F9  F10 F11 F12 Prt Scr Pwz
 -  F1  F2  F3  F4  F5  F6  F7  F8  F9  F10 F11 F12 Prt Scr Pwz

 ~   !   @   #   $   %   ^   &   *   (   )  Lt- Lt+  Bsp  Ins Hom PgU Num Sk/ Sk* Sk-
Esc  !   @   #   $   %   ^   &   *   (   )  Lt- Lt+  Bsp  Ins Hom PgU Num Sk/ Dk* Dk-

 Tab  Q   W   E   R   T   Y   U   I   O   P   [   ]    \  Del End PgD  7   8   9
 Tab  Q   W   E   R   T   Y   U   I   O   P   [   ]    \  Del End PgD  7   8   9  Sk+
                                                                                 Sk+
  Cap   A   S   D   F   G   H   J   K   L   ;   "   HCr              4   5   6
  Cap   A   S   D   F   G   H   J   K   L   ;   "   HCr              4   5   6

   LSh   Z   X   C   V   B   N   M   <   >   /   RSh      Up         1   2   3
   LSh   Z   X   C   V   B   N   M   <   >   /   RSh      Up         1   2   3  VCr
                                                                                 VCr
 LCt  LAl             SP              RAl  RCt Lft Dwn Rgt      0       .
 LCt  LAl             SP              RAl  RCt Lft Dwn Rgt      0       .

Arrow Keys: Move Top Cursor              F1 Key: Copy Top Label to Bottom Label
  Tab Keys: Move Top Cursor              F2 Key: Copy Both Tops to Bottom Labels
    CR Key: Move Bottom Cursor      Home/F9 Key: Reselect Style and Layout
            Under Top Cursor        End/F10 Key: Write Out Changes or Just Exit
```

FANSI Console *3.0 provides enhanced keyboard functions, even to older machines.*

New features in Version 3.0 include support for VGA adapters, enhanced keyboard functions for non–IBM-standard EGA video modes, and additional escape sequences, which allow software written for the VT100 to run on PCs. The enhanced keyboard functions work even on my old AT—now I can use the funtion keys F11 and F12.

Two drawbacks: *FANSI* takes 40K of memory, and it has a steep learning curve. But considering what it does give me, I'm a *FANSI* fan.

List Price: *FANSI Console*, Version 3.0, program and user manual, $75; with technical reference manual, $104.95. Upgrades available. **Requires:** 128K RAM, DOS 2.0 or later. Not copy protected. Hersey Micro Consulting, No Smoking Software, P.O. Box 8276, Ann Arbor, MI 48107; (313) 994-3259.

CIRCLE **441** ON READER SERVICE CARD

Keeping Ventura Publisher Tags in Your Computer's Memory, Not Yours

HANDS ON

BY EDWARD MENDELSON

All savvy *Ventura Publisher* users have written macros that enter format tags and special symbols into word processor files destined for *Ventura*. However, precious few *Ventura* users have all the macros they need—or can remember all the ones they have.

Metroplex Digital's $99 *PubStar* is a specialized macro program designed to ease the task of remembering all those tags. You pop it up over your word processor. Next, you choose a menu with lists of paragraph tags, format codes, point sizes, font names, special characters, or boilerplate text. Then you move the cursor to the tag or code you want and allow *PubStar* to enter it into your file. With most word processors, *PubStar* automatically moves to the beginning of a line when inserting a paragraph tag. (*PubStar* supports *WordPerfect*, *Microsoft Word*, *WordStar*, and *WordStar 2000*, but it can also be used with a number of other programs.)

Can't remember the codes for the copyright symbol or an em dash? *PubStar* pops up so you can pop them in. You can let the program collect tags from another document or a *Ventura* style sheet and automatically list them in *PubStar*'s menu.

The package includes a separate program that strips graphics characters, surplus spaces, and carriage returns from word processor files, so you can clean them up and then use *PubStar* to help transform them into files that *Ventura* can understand.

PubStar bites off 90K of RAM, and its $99 price is high for a macro program. But its convenient and ingenious design make it a powerful rival to your homegrown macros.

List Price: *PubStar*, $99. **Requires:** 90K free RAM, DOS 2.0 or later. Not copy protected. Metroplex Digital Corp., P.O. Box 815729, Dallas, TX 75381-5729; (214) 231-8944.

CIRCLE **442** ON READER SERVICE CARD

BatchMaker: Catch-22

HANDS ON

BY BRUCE BROWN

DOS batch files are supposed to make computing life easier, and *BatchMaker* is supposed to make writing batch files easier. Of course, writing batch files isn't that difficult for most DOS users. But if you're new to the game and you want a little assistance, then *BatchMaker*, Version 1.0, is fairly helpful.

The package contains a selection-and-execution screen for batch files, a full-screen editor, and a pop-up calculator. At a price of $59.95, *BatchMaker* is strictly a convenience item.

BatchMaker exists in a Catch-22 situation. To use it, you have to know enough about DOS to know what commands it will accept, and DOS can get pretty picky. The people who could get the most from *BatchMaker* probably don't write their own batch files, and the people who do write batch files don't need *BatchMaker*.

You can use word processing programs to write batch files and then save them in ASCII or DOS text format. And there's always DOS's own EDLIN. *BatchMaker*'s editor, however, is more convenient to use and better looking than EDLIN.

Beyond creating batch files, *BatchMaker* can be used to write various kinds of text files, but these files must be no longer than 500 lines of 78 characters each.

If you want to use DOS batch files, save the $59.95 you'd spend on *BatchMaker* and invest 30 minutes or so in learning to use EDLIN.

List Price: *BatchMaker*, Version 1.0, $59.95. **Requires:** 256K RAM, hard disk drive, CGA graphics or better, DOS 3.0 or later. Not copy protected. Northland Multisoft, Box 7237, Moreno Valley, CA 92303-7237; (714) 924-5781.

CIRCLE **443** ON READER SERVICE CARD

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CIRCLE 137 ON READER SERVICE CARD

Bridge/286, /386: Full-Featured Windows Batch Language Supports User-Defined Dialog Boxes, Menus

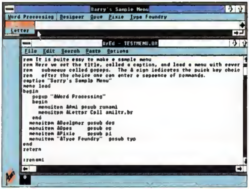
PC HANDS ON

BY BARRY SIMON

A friend once remarked that you learn the Apple Macintosh in 1 day and pay for that ease of learning every day afterward. In the same way, you pay for the gentle nature of *Microsoft Windows*' graphical interface each time you toil with loading a program via the MS-DOS Executive or cycle through all your open windows to get to the application you want.

Bridge/286 and *Bridge/386*—full-featured batch languages for the 286 and 386 versions of *Windows*—were designed by SoftBridge Microsystems to make *Windows* easier to use.

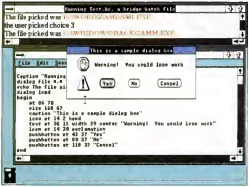
Despite its name, *Bridge/386* will run under either *Windows/286* or *Windows/386*. In addition, a *Bridge* Software Development Kit (SDK) is available, consisting of both products and a number of advanced tools. A Presentation Manager version is also in the works.



```
rem It is quite easy to make a sample menu
rem Here we set the title, called a caption, and load a menu with sever
rem   submenus called popups.  The & sign indicates the quick key choic
rem   after the choice one can enter a sequence of commands.
caption "Barry's Sample Menu"
menu load
begin
   popup "&Word Processing"
   begin
     menuitem &Ami gosub runami
     menuitem &Letter Call amiltr.br
   end
  menuitem &Designer gosub des
  menuitem &Opus     gosub op
  menuitem &Pixie    gosub pi
  menuitem "&Type Foundry"  gosub typ
end
return

:runami
```

The Bridge *batch file in the lower window is generating both the dialog box and the messages in the upper window.*


Running Test.br, a bridge batch file
This is a sample dialog box
Warning! You could lose work
Yes
No
Cancel
File
Edit
Sear

```
The file picked was [illegible]
the user picked choice 3
The file picked was C:\WINDOWS\BACKGAMM.EXE
```

```
Caption "Running
dialog file a.e
echo The file pi
dialog load
begin
    at 86 70
    size 160 67
    caption "This is a sample dialog box"
    icon at 14 2 hand
    text at 36 11 width 29 center "Warning!  You could lose work"
    icon at 14 30 exclamation
    pushbutton at 43 37 "Yes"
    pushbutton at 88 37 "No"
    pushbutton at 118 37 "Cancel"
end
```

The Bridge/286 *and* Bridge/386 *batch files allow you to define your own* Microsoft Windows *menus and submenus with simple commands.*

Two of the most notable features of this batch language concern control of the keyboard and display aspects. You can set up dialog boxes—either "quick dialogs" to get things like a YES/NO response or filename, or full-fledged dialogs, in which you can control positioning of radio buttons, scrollable lists, and window location and size. You can also define your own menus and pop-down submenus.

A powerful On Key command allows you to assign *Bridge* commands to specific keystrokes within each application. For example, you could arrange to define Ctrl+Alt+E to load *Microsoft Excel* if it is not already loaded and, in any event, to make *Excel* the active application. The *Bridge* command can call an entire subroutine and can even place keystrokes in the keyboard buffer for a particular application to receive.

While these commands are powerful, there are some annoying limitations. For example, you can't distinguish the + on the top row from the + on the numeric keypad, and you can define hotkeys only within individual programs or within all *Windows* applications. The ability to define global hotkeys with a single command would be a real plus.

Bridge understands *Windows* at an intimate level. There are *Bridge* batch commands to move and resize windows, to cut an area to the windows clipboard, and to change the active application.

The array of language elements available with *Bridge* is comparable to the best DOS-level batch extenders like *Beyond Bat, Command Plus*, and *Extended Batch Language*. It offers variables, arrays, and several powerful constructs, including for loops, if-thens, gotos, and gosubs. The case construct is conspicuously missing. You can branch on whether a given application is loaded or whether a given file exists. There are also informative error messages and a trace facility.

The *Windows* environment is especially pleasant for writing batch files since you can split the screen between the Notepad where you type the batch files and the *Bridge* output area.

Bridge also boasts powerful network support, including a feature that allows several stations on a network to exchange messages with commands triggered when a message is received.

For the more detailed dialog boxes and menus, the syntax can get tedious. There is help on the way, though, in the form of a special *Bridge* file editor. Now included as a beta version in the SDK, the editor allows you to interactively arrange the dialog boxes as they appear and have the code generated for the *Bridge* batch file.

Bridge/286 and *Bridge/386* are impressive programs. If you use *Windows* with a variety of applications and have any facility with languages, you'll want a copy—provided you can get past its price—pretty high for a utility.

PC MAGAZINE FACT FILE

***Bridge/286*, Version 1.0**
***Bridge/386*, Version 1.0**
SoftBridge Microsystems Corp.
125 Cambridge Park Dr.
Cambridge, MA 02140
(617) 576-2257

List Price: *Bridge/286*, $149; *Bridge/386*, $299; Software Development Kit, $695.

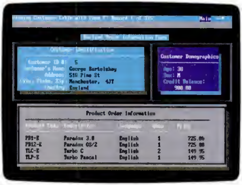
Requires: 512K RAM (640K recommended), *Microsoft Windows/286* or *Windows/386*, DOS 2.0 or later.

In Short: Enhanced batch language for the *Windows* environment. Includes user-defined menus and dialog boxes, a keyboard stuffer, and macro capability. Not copy protected.

CIRCLE 447 ON READER SERVICE CARD

✓ INTRODUCING PARADOX 3.0

Power without pain.



Customer ID #: 5
George Bartelshey
510 Pine St
Manchester, 4JT
England

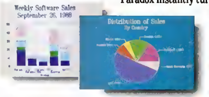
Customer Demographics
Age: 30
Sex: M
Credit Balance:
900.00

PB1-E	Paradox 3.0	English	1	725.00
PB12-E	Paradox OS/2	English	1	725.00
TLC-E	Turbo C	English	2	149.95
TLP-E	Turbo Pascal	English	1	149.95

Multi-table form dynamically displaying information from three related tables.

You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

Paradox 3.0 is all powerful and never painful because *it* makes all the complex inside moves, you don't. While it does the complex for you, the complexity is hidden beneath clear, natural, even intuitive pathways and patterns that make life easy for you.



With Paradox 3.0, there are no Unclears, no Unknowns. You don't need an army of in-house technical support people. And best of all, you *don't have to be a programmer* to be a pro with Paradox. It's all gain, no pain.

"Query-by-Example" for example

✓ Use this checkmark and you're using QBE. It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer right now. And how much programming to do all that? Zero.

If your database experience so far is limited to the flat-file type rather than relational, or even if a spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

Record-locking and Auto-Refresh make the network safely network

Paradox has become the leading networker because it handles multi-users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

Once the record has been changed by someone in the network, ***Auto-Refresh*** kicks in ***automatically*** and updates everything. Everyone in the network is looking at up-to-the-minute information.

Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with *one* keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.

Award-winning Paradox Family

Paradox 3.0 is the latest addition to the award-winning Paradox Family. **Paradox OS/2 and 386 received PC Magazine's BEST OF 1988 AWARD in the database category.**

✓ it out

To order a trial version of Paradox 3.0 ($14.95) or a demonstration disk ($4.95), call (800) 345-2888, extension 100. Paradox owners may upgrade ($175.00) by calling (800) 331-0877. (Please have your serial number available.)

60 day money-back guarantee*

*Customer satisfaction is our main concern; if within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund. All Borland products are trademarks or registered trademarks of Borland International, Inc. Other brand

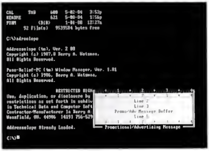
BORLAND

PC UPDATE

by Paula Seefeldt

Addresselope Expands Printing Capacity

Addresselope, the envelope-addressing utility from Barry Watzman, can now accumulate as many as 16 addresses and print them simultaneously. Version 2.0 also has the ability to print a message on the envelope for advertising or promotional purposes and provides automatic address capture and return addressing. *Addresselope*, Version 2.0, is available for $46.95. Barry Watzman, Mansfield, Ohio; (419) 756-5295.



```
CAL      TAB      600   5-02-04   3:53p
README            621   5-00-04   1:56p
FORM       <DIR>        1-01-80  12:27a
        92 File(s)   9539584 bytes free

C:\>adrselope

Addresselope (tm), Ver. 2 00
Copyright (c) 1987,8 Barry A. Watzman,
All Rights Reserved.

Pane-Relief-PC (tm) Window Manager, Ver. 1.01
Copyright (c) 1986, Barry A. Watzman,
All Rights Reserved.

                      RESTRICTED RIGH
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restrictions as set forth in subdiv          Line 2
in Technical Data and Computer Soft          Line 3
Contractor/Manufacturer is Barry A   Promo/Adv Message Buffer
Mansfield, OH. 44906  (419) 756-529          Line 5

Addresselope Already Loaded.        Promotional/Advertising Message

C:\>
```

Addresselope *now prints messages.*

ServiceMagic Adds Scheduling Ability

Magic Solutions has added a scheduling function to ***ServiceMagic***, its field service management software. This feature provides an overall personnel view and access to individual schedules. Users may also view customers' service histories and review service calls, parts serviced, and problem descriptions. *ServiceMagic* is $4,000 for a single user, with an optional Report-Generator available for $995. Magic Solutions Inc., Franklin Lakes, N.J.; (201) 891-6383.

ITC Automates Overhang Reports

ShareData has added several new features to its ***Investor Tracking Capability*** **(*ITC*)**. Version 2.0 simplifies the preparation of a prospectus for an initial public offering and can automatically generate an overhang report. Upgrades to Version 2.0 are available for $2,500; new packages retail for $5,000. ShareData Inc., Sunnyvale, Calif.; (408) 746-3666.

Automenu Provides Network Enhancements

Automenu, the shareware menu product from Magee Enterprises, has added Network Enhancements. Version 4.5 is fully network compatible and has several new features designed for greater ease of use. The updated product offers faster screen writing, an improved menu-building facility, and the ability to execute menu selections from DOS. Upgrades are available for $10 and new products will continue to retail for $50. Magee Enterprises, Norcross, Ga.; (404) 446-6611.

CompareRite Extends Text Features

Jurisoft has released a new version of its redlining program, ***CompareRite***. Version 3.0 offers several new features, including the ability to distinguish between changed text and text that has been moved within a document. The upgraded package also provides a "Skip Text" option, a "Compare Footnotes" feature, and the *CompareRite* Viewer that allows users to choose from three different methods to view drafts. A single key command is used to automatically move the user from one change to the next. Upgrades are $15 to registered users and $30 to other users. New packages are available for $129.95. Jurisoft Inc., Cambridge, Mass.; (617) 864-6151.

XyQuest Expands Technical Support

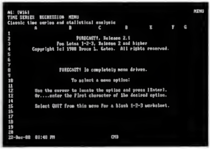
XyQuest has expanded its technical support service. The new services include expanded hours, an electronic reference board, subscription to *XyWrite Application Notes*, and an update to the current copy of ***XyWrite III Plus***. XyQuest's technical support staff will be available during expanded evening hours and phone support is free to registered users. XyQuest Inc., Billerica, Mass.; (508) 671-0888.

ACCPAC Price Increase

Computer Associates has increased the prices of its ***ACCPAC*** accounting products. The ***ACCPAC Plus*** core line has increased $100 to the new price of $795 per module. Computer Associates, San Jose, Calif.; (408) 432-1727.

Forecast! Extends Regression Variables

Forecast!, Intex Solutions' forecasting package for Lotus users, has added a statistical analysis capability. Version 2.1 also supports up to 12 regression variables, handles 300 observations, and performs 52-week seasonality for week-of-the-year analysis. Diagnostics provide mean absolute percentage error (MAPE) and degrees of freedom for all models. Upgrades are available for $45, and new packages retail for $145. Intex Solutions Inc., Needham, Mass.; (617) 449-6222.



```
A1: [W16]                                                      MENU
TIME SERIES  REGRESSION  MENU
Classic time series and statistical analysis
        A          B          C          D         E        F    G
1
2                    FORECAST!, Release 2.1
3               For Lotus 1-2-3, Release 2 and higher
4        Copyright (c) 1988 Bruce L. Gates.  All rights reserved.
5
6
7
8                 FORECAST! is completely menu driven.
9
10                     To select a menu option:
11
12        Use the cursor to locate the option and press [Enter].
12        Or....enter the first character of the desired option.
14
15        Select QUIT from this menu for a blank 1-2-3 worksheet.
16
17
18
19
20
22-Dec-88  01:40 PM                        CMD
```

Forecast! *has added statistical analysis.*

Bulldog *loves low prices!*

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386 Desk Pro 40/60/130	**$3950/4895/6289**
286 Desk Pro 12 mhz	**1695**
Compaq II Model IV	**2879**
Compaq Port. 386 Model 40/100	**5649/7199**
Compaq III 20mb/40mb	**3595/4150**
Compaq 386-S model 1/20/40	**2925/3465/3695**
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Model 30 w/1 floppy & 20 mg.	**1725**
Model 50 Z - 20/30/60	**2550/ 2750/ 3450**
Model 60 - 40 meg	**3295/**
Model 60 - 70 meg	**3650**
Model 70 - 60 meg.	**4325**
Model 80 - 40 meg.	**4270**
Model 80 - 70 meg.	**4875**
Model 80 - 115 meg.	**6195**

90 day warranty through Bulldog

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80387-20	**$499**
80387-25	**799**
803-87-16	**399**
802-87-8	**229**
80287-10	**269**
8087-3/8087-2	**104/149**
256K Chips/64K Chips	**Call**

COMPATIBLE

8 MHZ TURBO

1 floppy, 640K, AT style keyboard, 8 slots, 4 drive bays, monographics card, mono monitor	**$725**

Color System add **$150** w/20mb add **$269**, w/30 mb add **$289**

90 day warranty through Bulldog

286 BULLDOG 10 MHZ

1 mb Ram, 1.2 floppy	**$1095**
Bulldog 386 16 mhz, 1 mb Ram, 1.2 floppy	**$1795**
One year on-site warranty!	**$50**

AST

AST Premium 286 Model 80, 10 mhz, 0 wait state, 512K, DOS, keyboard, 1.2 floppy	**$1495**
AST Premium 386 Model 300 20mhz, 1.2 floppy, 1 mg., DOS, keyboard	**$2875**

All AST computers carry a 1 year warranty

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Toshiba 1000	**825**
Toshiba 1200	**2299**
Toshiba 1200F	**1395**
Toshiba 3100	**3095**
T3200	**3745**
T5100	**4795**
Zenith Super Sport 20 mb	**2325**
Zenith Super Sport 286 20 mb	**3399**
Epson Laptops!!	**Call**

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GENOA VGA 5100/5200	**239/359**
HERCULES GRAPHICS	**181**
HERCULES IN COLOR	**219**
ORCHID DESIGNER VGA w/256	**229**
PARADISE Auto Switch 480	**179**
PARADISE VGA Plus	**265**
PARADISE VGA Professional	**479**
QUADRAM EGA PLUS	**179**
w/mouse	**239**
STB CHAUFFEUR HT	**135**
STB Multi Res. II	**169**
VEGA DELUXE	**189**
VEGA VGA	**265**

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AST RAMPAGE 286	**385**
AST RAMPAGE 286-2 for MODEL 50/60	**549**
AST HOTSHOT	**355**
EVEREX MINI MAGIC w/o K	**59**
FAST 88/V20 w/Switch	**89**
INTEL Above Board 286 w/512K	**379**
INTEL Above Board PS286 w/512K	**409**
INTEL Inboard 386 w/Adapter	**1075**
INTEL Inboard 386 for PC w/1 mb	**799**
INTEL Above Board II for PS/2 w/o K	**259**
IRMA BOARD II	**685**
LOGICAL Connection 256K/512K	**429/499**
ORCHID Ramquest Extra w/o K	**279**
ORCHID Ramquest XT/At w/o K	**225**
ORCHID Ramquest II 2 w/o K	**169**
ORCHID Tiny Turbo 286	**259**
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GENIUS MOUSE GM6+	**$59**
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MICROSOFT MOUSE w/PC paint brush	**99**
MOUSESYSTEMS MOUSE	**89**
LOGITECH MOUSE C7 Plus/Hi Res	**69/89**
LOGITECH Scan Man	**199**
Z-NIX Supermouse w/Dr. Halo III	**59**
KODAK DATA SHOW	**750**
MICROFAZER II w/64K	**229**

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FX 850 264 CPS, 54 NLQ	339
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LQ 950	589
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OKIDATA

182 Plus 180 CPS, 30 NLQ	229
320/321 300CPS, 62 NLQ	339/465
390 24 pin 270 CPS, 90 LQ	465
391 24 pin 270 CPS, 90 LQ	639
292 240 CPS, 100 NLQ	439
293 Plus 240 CPS, 100 NLQ	575
393 450 CPS, 120 LQ	925

TOSHIBA

321 SL 216 CPS, 72 NLQ	469
351 SX 350 CPS, 100 NLQ	885
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2200	349
5200	519
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1080i Model II	189
1091/1092 Model II	199/339
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Laser Series II	1695
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IBM

Proprinter III	495
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6 foot parallel cable $19

We also carry printer ribbons for all of the above printers. Call for pricing

DRIVES

Seagate 20mb w/contr. ST225	$269
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Seagate 40 mb for AT ST251-1	419
Seagate 40 mb for AT ST251	349
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CMS 5¼" ext. 360K for PS/2	215
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Toshiba 3½" 720K int.	89
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Bernouli Box II 5¼" 20 mb int.	955
20 mb external w/card	1195
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IBM

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Microsoft Word 4.0	189
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Microsoft Windows 386	119
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Multiplan	135
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Peachtree II Complete	149
PFS Prof Write	119
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Everex 60 m.b. Teac int/ext	$550/645
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CIRCLE 481 ON READER SERVICE CARD

COMMUNIQUÉS

by Bill Howard

Turbo Expert.
Now it doesn't take a genius to plug into Expert Systems.

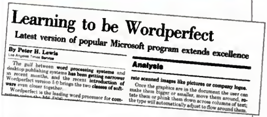
Nor does it take a genius to see you don't need the grounding adapter with this wall outlet. (Software Artistry ad for Turbo Expert)

Pruning Scissors Not Included

"Sizzle! Tear through your biggest spreadsheet like butter on this Compaq Deskpro 386, Model 60. With an Intel 80386 CPU chip cranked up to 20 megaHertz. A 60 megabyte hard drive. A 3.5 inch floppy drive. . . . This system's ready for serious business right out of the box! So we include one box of 5.25" diskettes, a surge suppressor . . . ."

—*Businessland Direct sweepstakes flyer*

Easy as 1-2-3, as the box for this Fisher-Price potty trainer declares? Well, you could call it an operating environment.



Learning to be Wordperfect

Latest version of popular Microsoft program extends excellence

By Peter H. Lewis
Los Angeles Times Service

Analysis

The gulf between word processing systems and desktop publishing systems has been getting narrower in recent months, and the recent introduction of Wordperfect version 5.0 brings the two classes of software even closer together.

Wordperfect is the leading word processor for com-

rate scanned images like pictures or company logos.

Once the graphics are in the document the user can make them bigger or smaller, move them around, rotate them or plunk them down across columns of text; the type will automatically adjust to flow around them.

Or almost WordPerfect. *Microsoft's product, of course, is* Word. (Austin, *Tex.*) American-Statesman, *August 1, 1988)*

DOYNK
PERSONAL COMPUTERS
RESEARCH AND DEVELOPMENT

"I DON'T GET IT. WE'VE MADE IT SMALLER, FASTER AND LESS EXPENSIVE, AND IT STILL DOESN'T SELL! JEEZ BOBBY, DON'T LEAN ON THE MOUSE LIKE THAT."

Amazing Facts I

"Hardware is half the story. The Connection CoProcessor is further enhanced by the Intel Communications Amplifications Specification, a programming interface designed to bring uniformity to file transfer."

—Personal Computing, *September 1988 (the spec is CAS or DICAS, for DCA/Intel Communicating Applications Specification)*

Amazing Facts II

"And just to make things interesting, IBM announced two new versions of the IBM Model 30, the E-01 and E-21 systems, without IBM's Mac architecture, which, if you can keep track, is IBM returning to the IBM standard."

—*Associated Press Compu-Bug column,* Richmond *(Va.)* Times Dispatch, *October 16, 1988*

Have you seen anything offbeat, unusual, or just plain dumb about the computer industry? If so, then send submissions to Communiqués, PC Magazine, *One Park Ave., New York, NY 10016. Contributors whose entries are used will receive $50 and a* PC Magazine *T-shirt. Don't circle or make permanent marks on submissions that might be reproduced as artwork (use a Post-it or mark up a photocopy). In case of duplicate entries, the earliest postmark will prevail.*

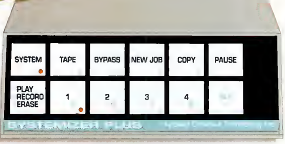
Winners this issue: Carl Thor (doesn't take a genius), Ned Benson (Microsoft WordPerfect), Sherman Doll (potty trainer), Gerald Reid (IBM Mac architecture), Joseph Ellett (CAS spec), Saxton Weir (Businessland).

Illustration: Richard Tennant

Introducing

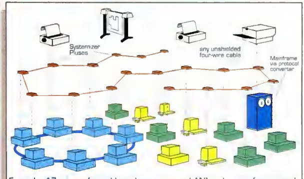
The NEW Systemizer Plus

The Ultimate in Connectivity!



Up to 31 users can...

- Share Printers
- Share Plotters
- Share a Modem
- Share a FAX
- Exchange EMAIL
- Transfer Datafiles


Systemizer Pluses
any unshielded four-wire cable
Mainframe via protocol converter

Example: 17 micros (mixed brands, some on a LAN) and a mainframe, each equipped with a Systemizer Plus, sharing 3 printers, a plotter, end EMAIL.

Systemizing has become the connectivity standard at many of the world's largest corporations and throughout the federal government. Ten's of thousands are already in use. The new Systemizer Plus is the latest model in Applied Creative Technology's line of Systemizing products, and it delivers what 95% of corporate computer users want from a Local Area Network— at far less cost and complexity, and yet with much more versatility.

Corporate computing managers prefer Systemizing over other connectivity methods because it offers:

- Up to 62 IO ports, each parallel *and* serial capable.
- Compatibility. Mix PC's, LAN's, mainframes, laptops.
- Easy owner installation. Low cost cabling.
- 5 min. user training with no support needed after.
- Flexibility; readily accomodates growth and changes.
- Powerful distributed buffering (up to 31 Megabytes)
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Call 1-800-433-5373 to get a FREE demo!

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CIRCLE 477 ON READER SERVICE CARD

THE FOXBASE+ EFFECT

Nothing gets through your workload faster than FoxBASE+. Because no other database package has more timesaving features.

Speed is something every manufacturer claims. But we'd quickly point out that FoxBASE+ outpaces every other package in popular tests by margins so staggering, you'll wonder how you ever managed with ordinary software. In fact, FoxBASE+ 2.10 is the fastest dBASE-compatible database system.

Most publishers claim "compatibility" too. But the fact that you often have to re-write parts of your program is curiously omitted. That's why you'll appreciate FoxBASE+'s ability to run all your dBASE applications immediately – without changes.

FoxBASE+ not only supports the dBASE standard, but also allows you to enhance your applications with special features which include two-dimensional arrays, user defined functions, filtered indexes and new commands to create pop-up and pull-down menus.

Best of all though, is the term "user friendly". Often a misnomer for weeks of training with mind numbing manuals. Hardly easy.

That's why FoxBASE+ includes features that enable you to get working right away.

FoxCentral is a new type of user interface. Using pull-down and pop-up menus, you can perform every important database operation without programming!

FoxView is a screen design tool that helps you create beautiful custom data input screens.

FoxCode is our new applications generator that can easily produce the simplest or most sophisticated applications for you.

You can even document your programs automatically with **FoxDoc** by simply pressing a few keys.

FoxBASE+ is available in a variety of versions for the most popular operating environments including MS/PC DOS, Macintosh and UNIX/XENIX. There's even a 386 version! FoxBASE+/LAN supports an unlimited number of users on a network (No LAN PACKS required). Our Unlimited Royalty-Free Runtime allows extremely economical distribution of an unlimited number of your applications without incurring any royalty fees.

And if you want to add another dimension to your data use FoxGraph, the exciting new graphics package from Fox.

Take a look at FoxBASE+ today. You won't find a more powerful dBASE-compatible relational database management system. FoxBASE+ retails for $395, FoxBASE+/LAN for $595 and FoxGraph for $295 at your local quality software dealer. Or call 419/874-0162 for more information and a free demo-package. Ask for extension 760.

dBASE is a registered trademark of Ashton-Tate.
FoxBASE+ is a trademark of Fox Software Inc.

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CIRCLE 112 ON READER SERVICE CARD

■ **BILL MACHRONE**

VIRUSES: SENSE AND NONSENSE

Like it or not, viruses have changed the way we compute. But some people who should be helping to solve the problem are acutally making it worse.

Some time ago I was on a business trip to Cleveland. With me was one of my associates, a veddy proper young British woman named Liz. Back in those early days of baggage inspection, passengers could see the X-ray imaging screen. We watched as our bags went through. In Liz's makeup case, lipstick tubes and whatnot fell together in an unfortunate pattern. I asked, "You still carrying that derringer, Liz?"

You can guess what happened next.

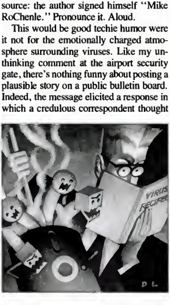
LOADED GUN No one can deny that deranged or vindictive people create viruses and unleash them on an innocent public. My unthinking comment 10 years ago caused a few problems; a bunch of unthinking actions today are making the virus situation worse than it has to be.

I've seen some wonderful nonsense circulating lately that would be funny if it weren't so scary. One of the more recent offerings was a message left on a bulletin board from a purported telecommunications expert. He alleged that his system had been wiped out after connecting to an on-line system. He recognized the symptoms of a virus attack—erased files and flaky behavior. Worse, the story went, if he contacted another system via his 2,400-bit-per-second modem, it would be infected too. The supposed disease vector was a 300-bps subcarrier channel indigenous to all 2,400-bps-and-faster modems. While the user merrily uploads and downloads files at 2,400 bits per second, the nefarious virus takes over the modem through subcarrier signals and subverts incoming binary files so that it can spread itself to any other 2,400-bps modems.

We are to believe that the code being received by the subcarrier somehow finds its way into the system, there to wreak havoc, and then sends itself out to the next unsuspecting system courtesy of this undocumented subcarrier in 2,400-bps modems. The note ended with a stern warning not to use 2,400-bps modems, adding that this message was being uploaded with an older, uninfectable 1,200-bps unit.

If you believe this hogwash, consider its source: the author signed himself "Mike RoChenle." Pronounce it. Aloud.

This would be good techie humor were it not for the emotionally charged atmosphere surrounding viruses. Like my unthinking comment at the airport security gate, there's nothing funny about posting a plausible story on a public bulletin board. Indeed, the message elicited a response in which a credulous correspondent thought that Mike RoChenle's discovery exactly described a problem he was having and thanked him for alerting the world to the dangers of 2,400-bps modems.

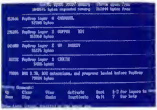


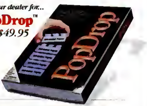
HOMEBREW VIRUSES Meanwhile, I've just seen what may be the most ill-conceived computer book ever. I can't bring myself to tell you the title, author, or publisher. This book about viruses strikes me as the height of opportunistic publishing and bad judgment.

We get a continuous flow of books for review from the various computer-related publishing companies. They range from benign (*Using Quattro*) to investigative (*Once upon a Time in ComputerLand*, the story of Bill Millard's fall), to vitriolic (*Accidental Millionaire*, a chronicle of Steve Jobs's rise). This one is different. Instead of a book offering ways to protect yourself against viruses and decontaminate an infected system, this is a how-to manual.

Hidden behind flimsy "don't try this at home, kids" disclaimers are source code listings for some fairly nasty viruses, including the IBM "Christmas" virus. There's something here for everyone. Mainframers will be thrilled with the complete listing in EXEC of the Christmas virus. There's enough of a BAL (mainframe assembly language) virus for any enterprising coder to build a real humdinger. And he hasn't forgotten the PC crowd. You have your pick of viruses in assembler, Pascal, BASIC, and DOS batch language. The author has some swell guidance for hiding viruses from users and system administrators alike, couching de-

Illustration: Darryl Ligasan





structive viruses in benign or supposedly helpful batch files and in the source code to programs.

This book honestly reminds me of a treatise on capital punishment where the author gets hung up on the techniques instead of the moral and legal issues: Is lethal injection really better than gas? The electric chair, of course, is beneath contempt. But maybe some enterprising soul will bring back the firing squad.

I knew this book had gone beyond the pale when I got to the chapters on attacking hardware, which included techniques for destroying monitors and disk drives with software. The lone chapter on protection techniques is lame. It covers hunter programs that look for viruses with known signatures, and it breezes over hardware protection methods. But the author's conclusions are obvious: locks keep out honest people, and there is little defense against a determined onslaught.

The book ends with a treatise on how viral programs may be the key to artificial intelligence because of their devious and self-modifying nature, implying that the work being done on viruses today may result in humanlike thought processes for computers tomorrow. This makes about as much sense as saying that the viral forms that subvert our cellular mechanisms to give us colds and chicken pox might spontaneously recombine into a new, intelligent life form. If they ever do, I can't imagine what I might want to say to them.

Still, there is hope. Antivirus programs are relatively effective. Control programs, such as FoundationWare's *CPR*, check date and time of creation, file length, checksum, and a few other items to keep users' machines from running anything not on the approved list. Software vendors and operating system designers may have to get in on the act. It may become necessary to provide separate authorization codes or public keys to the file-loader portion of the operating system to prevent infected programs from running.

It isn't that bad yet. Some of us will go our entire computing careers without ever seeing a virus. Most of us will never be on a plane that gets hijacked. Yet we all submit to the restrictions that protect the airborne fleet against the whim of the madman. Can our computers be far behind? ▣

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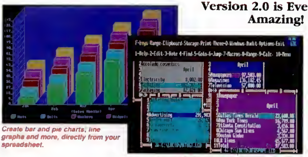
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Media Code #106

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Insilco

■ **JOHN C. DVORAK**

INDUSTRY TRENDS, 1989

Comparing this year's Comdex exhibitors' guide with the previous year's edition reveals the ups and downs in the computer industry in 1988.

Every year I like to compare the index of the Comdex exhibitors' guide with the previous year's edition to see the immediate year-to-year changes. Here are the results of this year's analysis.

First of all, things are on the upswing—the size of the guide has increased from 528 pages to 596 pages. As usual, the number of exhibitors listed in most categories of equipment stayed pretty much the same. I'm concerned only with changes—plus and minus. Immediately intriguing are the categories that were completely dropped from the listings in 1988: data acquisition and recording (13 exhibitors listed in 1987), interactive video (5 in 1987), teleconferencing (2), and finally, desktop publishing fonts (6). Any company from those categories that still wanted to exhibit at Comdex had to find a new category.

DECLINES AND SURPRISES Many classifications showed noticeable declines in exhibitor interest. There were 15 paper-forms-handling companies in 1987, 7 in 1988. Other downers included label forms (from 11 to 7), robotics (from 4 to 1), word processing equipment (from 15 to 8), security products (from 13 to 6), accelerator boards (from 16 to 8), multiuser systems (from 49 to 42), computer phones (from 6 to 2), LAN gateways (from 22 to 15), and printer buffers, which dropped from 19 to 14 exhibitors.

Many of these declines are easy to figure out. Laser printers, which are fast and need no buffers or forms handling, have grown more popular. Their success affects other equipment. Interestingly enough, few new vendors entered the laser printer fray (there were 39 in 1987, 42 in 1988). A bigger surprise was the recovered popularity of the daisy wheel printer. In 1987 only 7 vendors were listed; in 1988 there were 32! Daisy wheel printers win Dvorak's comeback-product-of-the-year award.

Other notable gains included companies specializing in documentation services (up from 5 to 13 exhibitors); another surprise was that floppy-disk-drive exhibitors increased from 21 to 31. Tape drives showed a big gain, going from 24 to 38 exhibitors. Also on the upswing were software and hardware testing services, up from 4 to 19. "Used computers" added a few companies—from 1 in 1987 to 4 in 1988. The bigger jumps, though, were mostly anticipated: LANs up from 54 to 76, personal computers up from 87 to a whopping 137. And the mice/joysticks list gained a big following, with an increase from 8 to 25 exhibitors.

NEW LISTINGS The group that fascinates me the most are the new categories. There were 14 in 1988. Some were obviously spun off from bloated or confusing ones. While listings of computer furniture companies appeared down (a drop from 39 to 27), this was partly because of the creation of a category called "cabinets and enclosures" (22 exhibitors), which used to be included in the furniture category. Another new category, called "page printer," which had 11 exhibitors, may have once been included with the lasers or who knows where.

Other new categories that appeared are image processing (27 entries), mother/daughterboards (59 entries), X.25 equipment (7), data recovery (4), fault tolerance (3), peripheral sharing devices (26), software/medical (10), software/security (17), software text management (7), and software services (15).

Although the mother/daughterboards listing leads the pack as the most popular new category, I didn't think this indicated as important a trend as the final two newcomers: facsimile (19 exhibitors) and fax boards (31). These two categories confirm the single most important trend in the world of business, home, or office—the sudden and astonishing growth and subsequent acceptance of the fax media as a messaging tool. Fax technology wins the Dvorak award as most significant technology of 1988.

You can probably interpret many other trends, big and small, from my little list here. One thing for sure—the business is thriving.

Illustration: Daryl Ligasan

DATACOPY

■ **JOHN C. DVORAK**

INSIDE TRACK

IBM's slip is showing. Loose lips sink Big Blue ships.

IBM has a problem. If there's a trend in this business, it's IBMers quitting the company to work for smaller, more entrepreneurial businesses where they can make a **financial killing** with stock options. This trend can be observed from two perspectives. The cynic may say that this is all for the better since IBM has been **clogged with deadwood** for years. Like a pro football team that's winning all the time, the company is plagued with too much complacency and brownnosing. Success hits the wall every so often. Just look at the Dallas Cowboys! Other observers feel that this is just plain nonsense and, simply put, the company is suffering a **brain drain** that will hurt it in the long run.

Whatever the case, the ex-IBMers have **one thing in common.** Like graduates from some common alma mater, they manage to keep up with events inside the company. They all talk as if they still know exactly what's going on there from minute to minute. This is obviously a function of past friendships and the common **gossip network** that these old employees remain linked into. Although plugged into this **inside information,** most of these ex-IBMers don't feel obliged to keep the company's secrets anymore. Why should they? The result of this is that we can expect to hear more and more inside scoops, gossip, and leaks from IBM.

We can also expect to hear more and more "True Confessions." **Tales of bumbling from the past.** I was recently told about how IBM dropped the ball with its **convertible** just before laptops took off in the marketplace. It seems that Lowe and Akers agreed that the laptop wasn't such a hot idea. So IBM held back a **backlit black-and-white LCD** that the company could have rolled out upon introduction. Now everyone is wringing his hands over the long-term possibility that a sizable laptop market share may be the key to successfully manufacturing the personal computer of tomorrow. Already we're seeing articles about how the desktop PC may become tomorrow's boat anchor. Anyway, I expect to hear more and more **revealing IBM anecdotes** in the years ahead.

Genuinely Interesting Software Dept.: Some software is just plain creative. I'm always **amazed** when I run into a product such as System Enhancement Associates' new utility, *Axe*. This is the company that helped popularize file archiving. Recently the company got into a silly legal beef with a competitor over the use of the extension .ARC to indicate an archived file. Ignoring that **fiasco,** let's look at this fascinating software. What *Axe* does is **shrink** your .COM and .EXE files by as much as 60 percent. Or so the company claims. I ran it on a bunch of programs and averaged about a 20 percent size reduction, which is **nothing to sneeze at** when you want to cram some extra programs on your Toshiba T-1000 RAMdisk. Garnering an extra 100K bytes or so can be quite useful in portable applications.

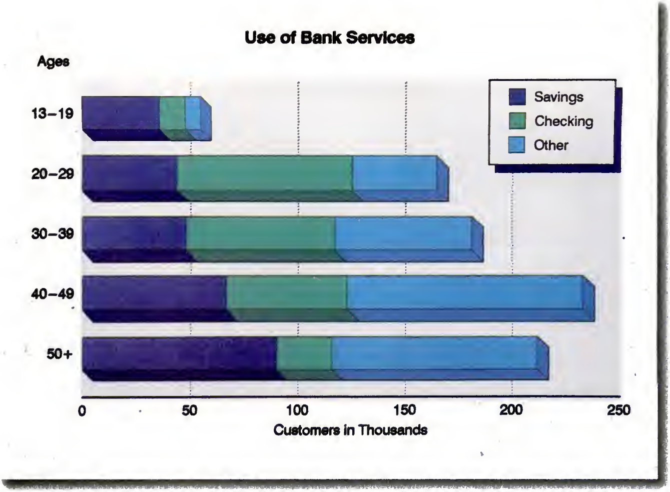
This $50 utility (available from SEA, 21 New St., Wayne, NJ 07470; (201) 473-5153) is not a program optimizer. It actually compresses the file as though it were archived. Placed within the compressed code is a **small executable module** that is triggered when the program is executed. The module quickly decompresses the program and starts normal execution. You'd never even know it was there. It works like a champ. If you have a hard disk that is filling up or if you use any portable, then you definitely need this program.

Exercises in Futility Dept.: I finally got called by that IBM/Sears crowd that produces a new videotext service called **Prodigy.** It was a direct-sales phone call to get me to subscribe. "Do you have a computer?" "Yes." "Is it PC compatible?" "Yes." "How much memory does it have?" "Eight megabytes." "Do you know if that's more than 512K?"

So I get the start-up disks and try it out. If you want a review in two words, try these: **it stinks.** The basic premise of the service is that **computer users are idiots.** It's a peculiar conclusion to draw about the people you're trying to sell to. The information content is close to inane, as if expecting the Prodigy user to be illiterate. Besides **superficial** condensed news and worthless stock market reports, there are 50-word columns from various columnists. It's incredible. There's also a movie review database.

Wondering how valuable the movie reviews were, I called up a couple of **X-rated movies** to see how this touchy area was handled. Take *Debbie Does Dallas* (please!). Here's the review/synopsis in its entirety: "Football cheerleader tries to go pro." Sounds like family entertainment to me. Here's the synopsis of *Debbie Does Dallas II:* "Cowgirl Debbie helps aunt bail out businessman." I'd think little Jimmy could learn a lesson about civics with this movie. I also checked the database for the **cult** classic *Mars Needs Women*. The synopsis never even mentions the weird appeal of this dumb movie but merely says, "Martians threaten to destroy earth unless they are given five women for test purposes." Gad.

This just **exemplifies the shallowness** of this ludicrous service, which is designed to promote advertising. Yes, at the bottom of each screen (which may take an ungodly 30 to 50 seconds to load!) is some **dubious** promotion. It gets old fast. Folks, this service is doomed. PC



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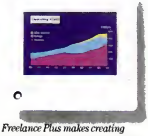

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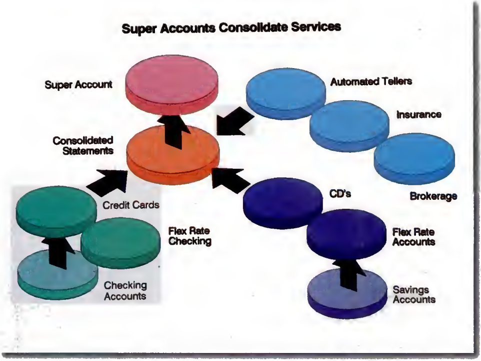

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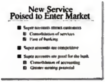

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■ JIM SEYMOUR

MICROSOFT VS. LOTUS

The two giants of the personal computer software industry are steadily moving in opposite directions. The future looks bright—but not for both of them.

Some comparisons are almost irresistible: Chicago vs. New York, Mercedes-Benz vs. BMW, L.A. Dodgers vs. Oakland A's. And Lotus vs. Microsoft.

I've written before about what's happening with these two behemoths of the PC software industry. Two years ago I said that I thought Lotus was moving into a period of great difficulty but would tough it out and emerge as a company with very good new products. I think that assessment is still pretty close to the mark.

And a year ago I wrote here that while Microsoft had become more technology-focused (and remained relatively inept at marketing), Lotus had become more of a marketing machine (at the expense of building its technical prowess). Since then, Microsoft hasn't gotten much better at marketing, and from all accounts, Lotus hasn't beefed up its technological resources very much.

Today, though, there is a little-noticed but absolutely fundamental rift growing between the two companies' apparent purposes and directions. If I'm right in reading the tea leaves, Microsoft is in the process of positioning itself to become a much bigger, much more important long-term player by making the right bets and plays today. And Lotus is on a path that will hardly lead to extinction, yet will not position it to play nearly so important a role a decade hence.

PC BIAS—FOR AND AGAINST Here's the gist of it: in its product-planning and corporate strategies, Microsoft seems to be embracing the PC—and the ideas behind PCs—without slipping into romantic nonsense about the glories of the personal computer, and without ignoring the enormous connectivity-related issues that are reshaping our business.

Lotus, by contrast, seems afraid of the PC and sometimes not a little embarrassed about it. The fear that the company's roots aren't deep enough or strong enough—or rather, perhaps, that the soil in which those roots were planted is too poor to support the kind of company Lotus thinks it ought to be—is a failure of corporate vision of huge dimensions.

Lotus is now refocusing its development process to emphasize transportable code that will let the company move applications relatively easily from one "platform" (read *operating system*) to another. They also want to deliver same-name applications that look and run the same on all those platforms.

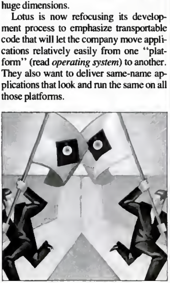

Illustration Daryl Lugasan

Fine. It's a great idea—developing applications that run on all the important platforms in this business and thus don't require expensive retraining for corporate people moving from one platform to another. And that idea is becoming a checklist item for many large corporations as they assess which new software standards they'll support, and which applications vendors they want to take on as their de facto partners for the 1990s.

But in the course of refocusing its development efforts and product line, Lotus is becoming what I'd call a very vertical company. Lotus thinks it's important that *1-2-3* run on Macs, on DOS PCs and OS/2 PCs, on Unix machines, and on mainframes. Hence the focus at Lotus on portable C code, recompiled and rejiggered for operating-system platforms as varied as Multifinder and VMS. Why else would Lotus reach the conclusion that *1-2-3/M*, the mainframe version of *1-2-3*, is still an important product—sufficiently important to keep it in a development process while Lotus is grievously late on delivering the DOS and OS/2 versions of its leading revenue-generator?

That strongly vertical orientation is responsible, I'm convinced, for a lot of the strain at Lotus over the last 18 months. And it will inevitably move Lotus away from its roots, and probably away from the possibility of developing genuinely great new software for PCs.

At Microsoft, by contrast, there is a similar emphasis on cross-platform code—and even more important, on delivering interoperability *today* in such key strategic products as *Excel*. But the company's focus still remains on delivering products to run on PCs.

Anyone who's looked closely at Microsoft's SQL Server plans can hardly claim that a relentless PC focus means the company doesn't appreciate the importance of connectivity. The client-server architecture embodied in SQL Server is exactly the kind of answer we need now—and will need for the next decade. It marshals the resources of each device, server and desktop PC, in a way that makes the most of those resources.

And Microsoft sure doesn't seem embarrassed by PCs.

Microsoft's focus seems to be much more on developing a richly horizontal series of products: software that exploits the PC as a PC and that also reflects a realistic understanding of the kinds of products companies want to buy today, and next year, and next decade.

HERE'S THE SCORE To the extent that this is a failure of one corporate vision running up against a wiser, more powerful view of what will build a strong software company in the 1990s, the strong-willed and variously charismatic leaders of the two companies must get the credit and blame, respectively. It's Gates 1, Manzi 0. And we're in the late innings, folks.

> ■ If I'm right in reading the tea leaves, Microsoft is positioning itself to become a much more important long-term player by making the right plays today.

I've painted this with a pretty broad brush, and of course that's unfair to both companies—to a degree. Lotus isn't about to stop shipping PC programs, and Microsoft doesn't have a lock on all the best ideas in PC software. But the two companies now seem to be set on very different paths.

If we the users, along with the investment community and the business and trade press, continue to base our comparison of the two companies on quarterly financials, or on difficulties with getting products out on time, we will miss seeing this profound shift in direction. PC

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■ **WILLIAM F. ZACHMANN**

OS/2 AND THE CHANGING SHAPE OF SOFTWARE

OS/2 will certainly affect the way the software we use looks and behaves. It might even make some industry software giants vulnerable to serious challenges.

The movement from DOS toward OS/2 is still in its early stages, but the transition is certain to accelerate significantly by the end of 1989. By this time next year, migration to OS/2 will be under way at a rapid rate.

At the same time, *Microsoft Windows* will continue to provide a path to many of the benefits of OS/2 for users who do not want or cannot afford to buy the additional processing power, memory, and disk storage that OS/2 requires. By providing the Graphical User Interface of the OS/2 Presentation Manager on less powerful systems, *Windows* will offer many users a less-costly alternative to OS/2 for some time.

BIG CHANGES AHEAD The shift toward OS/2 will bring big changes in the software applications used on personal computers. The Presentation Manager interface, the networking functions of OS/2 LAN Manager, OS/2's multitasking capabilities, and the access to the larger memory space that OS/2 provides all offer new possibilities for software. The changes that will have the biggest impact on users and on the fortunes of software vendors will be in the well-established, dominant application categories: word processing, spreadsheets, communications, databases, and graphics. Changes in products within these categories will result in serious challenges to the PC software giants of the past decade.

In spreadsheets, for example, *Lotus 1-2-3*'s position as the de facto standard for corporate number-crunching will be challenged as never before. Lotus's delays in completing *1-2-3*, Release 3.0, as well as in developing a version for the graphical environment of the *Windows Presentation Manager* make *1-2-3* particularly vulnerable.

TEXT VS. GRAPHICS While it is certainly possible to consider the market for spreadsheet software on IBM and compatible systems as a single market, the reality is that we are seeing an important segmentation between the world of text-based systems and the graphical environment. So far, *1-2-3* has remained the undisputed champion of the text environment, despite the challenge of lower-cost products with more features like Borland's *Quattro*. But a rapidly growing segment of the market is moving to the *Windows Presentation Manager* graphical interface. *Microsoft Excel*, which has already achieved a dominant position as a *Windows* application, is poised to repeat that success with an OS/2 Presentation Manager version.

Illustration: Darryl Ligasan

As the movement toward the *Windows Presentation Manager* interface accelerates, Lotus will find itself in the uncomfortable position of having to capture territory already firmly held by Microsoft with *Excel*. The graphics version of *1-2-3* will need to be not merely as good as but significantly better than *Excel* to succeed at all, let alone to gain the dominant position *1-2-3* has long enjoyed on text-based systems.

That poses a serious problem for Lotus. A major reason for users to stick with *1-2-3* is complete upward compatibility with the older, text-based versions of the product. Maintaining that compatibility, however, makes it extremely difficult to take full advantage of the opportunities a graphical interface provides.

What's more, the history of the battle between Lotus and Microsoft in the graphical environment offers little encouragement for Lotus. Microsoft's *Excel* for the Macintosh handily knocked out Lotus's *Jazz* in the early rounds of the fight a few years back.

Lotus may have learned something from that defeat and may come back much stronger. Still, comments by Lotus executives deprecating *Windows* and the Presentation Manager suggest that Lotus may be unwilling to recognize how critical it will be to have the best graphics-based spreadsheet in the future if its leadership position is to be maintained.

The problem of effectively translating a stunning success from the text to the graphical environment is a challenge that will be faced by word processing leader *WordPerfect* as well. Although Version 5.0 incorporated the ability to handle graphics and images to a limited extent, *WordPerfect* is fundamentally a text-based product.

Again, the Apple Macintosh provides an important test of the company's ability to succeed in the graphical environment. So far, the quite limited acceptance of *WordPerfect* for the Mac raises a serious question about its ability to make the transition.

Like *1-2-3, WordPerfect* faces a difficult trade-off between maintaining consistency with the text-based product and truly optimizing the design for the graphical interface environment. The result is a potential opening for competitors.

Here, too, software giant Microsoft is a serious contender. *Microsoft Word* has been a graphical product from the start; it already runs a strong second to *WordPerfect* in retail sales and appears to be gaining ground. Finally moved into *Windows* and the Presentation Manager, *Word* is essentially in its own natural environment.

In this case, however, yet another dark-horse competitor emerged last fall and may prove to be a serious contender. Samna's *Ami*, even more than the earlier versions of *Word*, does a superb job of taking advantage of the graphical environment to make complex tasks easy and understandable for the user. *Ami*'s use of style sheets, for example, offers users a much easier path to fantastic-looking output than *Word* does.

STILL MORE CHALLENGERS It isn't only the graphical environment that is changing the rules of the competition for software, however. Novell's *NetWare* certainly faces a serious challenge from the growing number of offerings based on the OS/2 LAN Manager. Ashton-Tate's dominance with *dBASE* will be challenged not only by PC alternatives like Borland's *Paradox*, but also by the intrusions of minicomputer DBMS packages like *Oracle* and *Ingres*.

There's no reason to assume that the leaders of the past will necessarily lose their leadership in the future. The right moves in adapting to the new environment may enable them to retain the dominant market shares they have enjoyed.

Still, there's no denying that companies like Lotus, WordPerfect, Ashton-Tate, and Novell face much greater challenges as a result of the transition in operating systems. Competitors who build products that fully take advantage of the capabilities of the OS/2 environment may have a unique opportunity to seize market leadership in key application categories. PC

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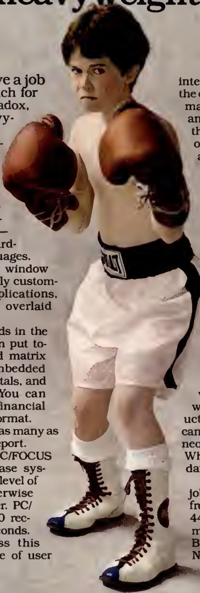

STEPHEN MANES

COSTLY HARDWARE? HUGE SOFTWARE? IT'S THE LAW!

Hardware adheres to the Law of Price Conservation. Software observes the Law of Program Inflation. And graphics standards obey no law at all.

Few things in life make you quite as intimate with recent history as an impending cross-country move. When every ounce you transport will cost you a couple of extremities, not to mention precious storage space in the new abode, you begin to see those supposedly "collectible" items you've been squirreling away from an entirely new perspective.

So it's out to the trash bin with the nearly complete old runs of long-defunct magazines such as *Personal Computer Age* and *Softalk* and . . . gee . . . it's kind of hard to resist peeking inside when titles such as "Unix on Micros" blare forth from the covers of early '80 rags.

Here's an interesting thought from January 1982: "Microsoft's proposed family of operating systems will also incorporate a significant feature—a graphics device driver that uses AT&T's proposed videotex graphics standard called PLP (Presentation Level Protocol) . . . . Think what it would mean if *all* 16-bit operating systems could support PLP. At last we'd have a *least common denominator* for graphics." Hmmm. *Presentation Manager*, anyone? *New Wave? X-Windows? Open Look? NeXT?*

ENDLESS AMUSEMENT And old price lists are endlessly amusing. Let's see: the original IBM PC, the 16K no-disk unit, went for a paltry $1,265. Add a $300 color/graphics card and a $75 RF adapter, hook up your TV set and your cassette recorder, and you could get down to some serious BASIC!

Of course, the only people who actually bought that machine were lowball hobbyists who put systems together from the frame up and blanched at forking over $570 for a single-sided floppy disk drive. At official IBM prices, a 64K machine complete with mono monitor, two single-sided floppy drives, and DOS went for a mere $3,615. IBM's dot matrix printer? A mere $755, plus $55 for the cable. Discounts? Ha! Hey, the things were on back order; you might have to wait a month or three just to get one!

Why, in 1982 Quadram was peddling a memory board with a princely 192K of memory for $795—the lowest price the pundit who wrote about it had seen to date. Things sure are different nowadays.

WHAT'S DIFFERENT? Or are they? As I lug the back issues to the dumpster, I'm struck by the realization that the system I'm thinking about buying now will cost me at least as much as the one I bought way back when. On the way back from the trash bin, I discover the Law of Price Conservation.

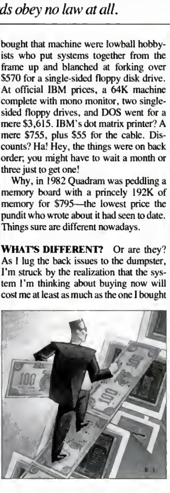

Illustration Darryl Ligasan

The Law states: *Your next system will cost at least as much as your last one*. Just when prices start dropping like a stone on the system you're considering, somebody inevitably develops a new must-have technology that ups the ante.

Consider floppy disk drives, probably the first premium-price option in the personal computer world. When they started getting cheap, hard disks arrived. When hard disks became mandatory, along came really *fast* ones. It's not unreasonable to surmise that within a couple of years, no machine will be complete without an optical disk drive—and its big price tag.

Look at monitors. Monochrome was fine until prices dropped to zilch. Then CGA became mandatory, followed by EGA and VGA. Now what you probably covet is a really *big* monitor—preferably driven by a card with higher resolution than the IBM standards.

Dot matrix and daisy wheel printers were expensive once. When prices took a nosedive, laser printers arrived to take up the slack with expensive memory and font options and costly expendables.

And, of course, the system units themselves keep adhering to The Law. The 64K 8088 was supplanted in quick succession by 640K models, 80286 units, machines with lots of extended or expanded memory, and 80386 hot rods. A couple of years from now, you won't be satisfied with anything less than a 486—and it'll cost more than the 386 you buy this year.

■ **STEPHEN MANES**

SEEDS OF TROUBLE Some of the blame rests squarely on software designers. The really old applications made virtually no hardware demands—and therefore fit on a single 360K floppy disk or two with easy-to-lift documentation. Hey, new operating systems are vastly bigger than applications used to be.

Clearly the seeds of trouble were sown when packages began to read "Hard disk required." Just trying to carry old versions of *Microsoft Excel* and *Microsoft Works* out the door at once was nearly enough to put me in traction. But *Paradox OS/2* took the prize: at nearly 11 backache-making pounds, it weighs more than many laptops. It won't run on them, either: its requirement of OS/2 and 3MB of system memory assures that it'll need one of those industrial-strength models that adhere to the Law of Price Conservation. Taking a cue from Parkinson, the Law of Program Inflation therefore states: *Software expands to fill the hardware available.*

BONFIRE OF THE VANITIES I do hope some place like Boston's Computer Museum is maintaining a collection of software for future scholars. Until my recent pre-move purge and bonfire, a brief history of the industry was written on my software shelf. Samuel Johnson wrote, "No place affords a more striking conviction of the vanity of human hopes than a public library." But he'd never seen the software library of someone who looks at the stuff for a living.

Odd fits of creativity aside, it certainly is an imitative world out there. As I cleared the erstwhile "keepers" from my shelves, I noticed a certain pattern: spreadsheets, databases, word processing, communications, spreadsheets, databases, et cetera, ad infinitum. There are now so many programs out there that do more or less the same thing in a slightly different way that it's hard to figure out what a new one's competitive edge is supposed to be.

Even if a program offers a competitive edge—some advantage in speed, features, or price—it still faces the biggest hurdle of all: training. That's the major reason why many users will wait forever for a promised upgrade of their favorite product rather than switch to another. It's the major reason why out-of-date programs remain best-sellers long after they've been surpassed by the competition.

Will developers recognize the problem and create genuinely new applications? Not likely. If the Law of Program Inflation and the Law of Price Conservation work as synergistically as they have in the past, you can bet the next new product will be a 10MB spreadsheet that "takes full advantage of the 486's processing power." PC

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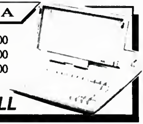

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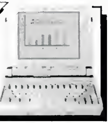

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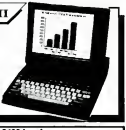

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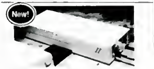

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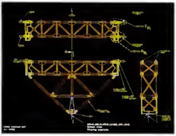
Shaded image of a completed MSL payload on the shuttle



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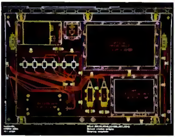
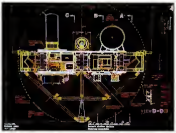
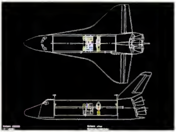


Detail of MSL, shown on MicroStation PC



Materials Science Laboratory (MSL), attached to the support structure, shown on MicroStation PC



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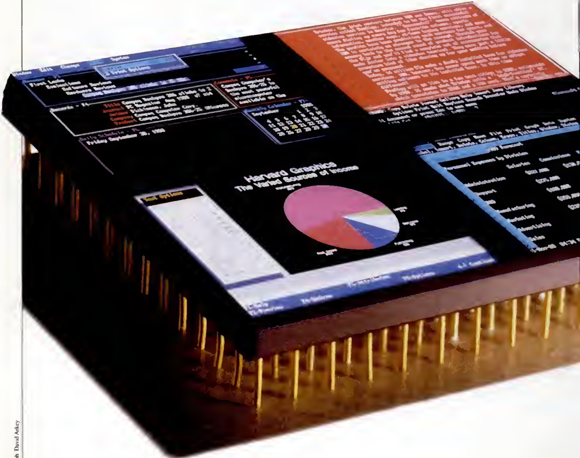
WHEN ONE PC EQUALS FOUR

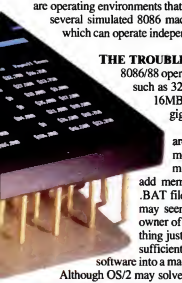
386 MULTITASKING



Photograph David Arkey

ENVIRONMENTS

The 80386 microprocessor is much more than just a very fast 8086. It has exciting capabilities entirely its own. While DOS by itself is not in a position to access these capabilities, a cadre of developers offer additions, enhancers, and replacements for the aging DOS that allow you to gain real advantage from the 80386 microprocessor without abandoning trusted DOS applications. Among the most popular solutions for single users of 386-based PCs are operating environments that allow multitasking: the creation and use of several simulated 8086 machines built entirely out of RAM, each of which can operate independently of the others.



THE TROUBLE WITH DOS Designed strictly as an 8086/88 operating system, DOS is oblivious to advances such as 32-bit registers, a maximum segment size of 16MB, memory paging, and support for up to 4 gigabytes of physical memory.

It isn't that some of these improvements aren't urgently needed. For example, ever more clever applications make increasing demands on memory at the same time that users add memory-robbing TSRs to their AUTOEXEC .BAT files. To the PC and XT owner, RAM cram may seem like the normal state of affairs. To the owner of an 80386-based machine, however, something just doesn't seem fair about receiving an "Insufficient memory" message when loading 650K of software into a machine equipped with 2MB of RAM.

Although OS/2 may solve the RAM-cram problem, it is only slowly appearing on the scene (Microsoft predicts it will be 1992 before OS/2 reaches 50 percent of the PCs). In the near future, OS/2 applications will begin to appear one by one like grass seedlings rising to the surface of a newly planted lawn. How long it might take before a full range of OS/2 offerings is available and how much it might cost to replace existing DOS applications

◆

Why wait for OS/2 to bring true multitasking to your 386 machine? Alternate operating systems can turn your 386 into four or more simultaneously functioning PCs today.

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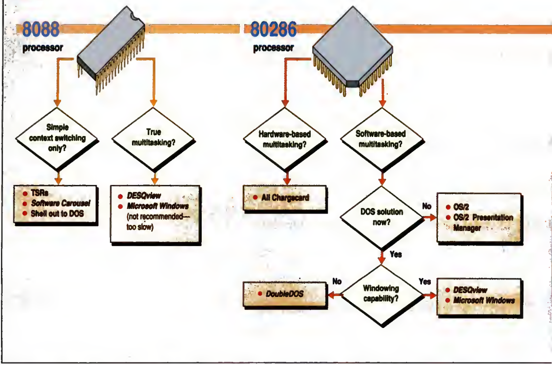
A Decision Guide for Multitasking Solutions



are anyone's guess. Besides, OS/2 still accesses only the 80286 subset of features. No official word is forthcoming on when an OS/386 might appear to take advantage of the rest, though rumors point to the end of this year or early in 1990.

If you want to bring some of the 80386's advances to existing DOS applications today, you have three options.

- You can extend DOS with utilities such as Phar Lap's *386/DOS-Extender* or Qualitas's *386-to-the-Max*. These relieve the RAM-cram problem somewhat without really affecting the way DOS operates.
- If that is not enough, you may opt for DOS-enhancement operating systems. These retain the basic DOS kernel but add significant functionality.
- If that is still not enough, the next logical step is to replace DOS with an entirely new DOS-compatible operating system that knows how to make more complete use of the advanced features of the 80386 chip. In this review we look at three DOS enhancers (*DESQview 386, Microsoft Windows/386*, and *VM/386*) as well as two DOS-compatible operating systems (*Concurrent DOS 386* and *PC-MOS/386*).

DOS EXTENDERS Most 80386-based PCs come with a utility that allows some minimal access to the 80386's capabilities. Such utilities are included to prove to you that your new machine is truly 80386 based, since no aspect of DOS would lead you to that conclusion.

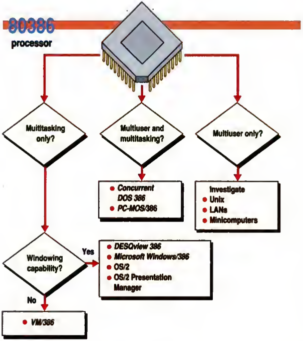
The most common trick that these utilities rely on is to copy the contents of the BIOS ROM into some area of the PC's RAM. The utility then uses the mapping capability of the 80386 to remap the logical address occupied by the ROM to the physical address of the copy. This results in a significant improvement in performance, especially in the case of the video BIOS. Programs that access the screen through the video BIOS can now execute from the 16- to 25-MHz 32-bit RAM rather than from the 8-MHz 8-bit video adapter connector.

Remapping logical to physical memory has other uses as well. Quarterdeck's device driver, *QEMM-386*, exploits the remapping capabilities of the 80386 to emulate LIM expanded memory specification (EMS) 4.0 memory. With this expanded memory specification, many application

The number of multitasking options you have depends on the kind of microprocessor you are currently using. Though the 286 is adequate for some multitasking, only the 386 has the power to create virtual machines through virtual 8086 mode. Keep these definitions in mind as you make your decisions:

- **Context switching** offers the look of multitasking without the power. Several applications can be loaded at one time, but those in the background are not active.
- **A multitasking system** is a single-user solution for actively running several applications simultaneously on one PC.
- **A multiuser system** allows several users to share the power and data of one PC.

Most multitasking software will run with microprocessors more powerful than those for which it was designed. For example, *Microsoft Windows* can be run on a 386 machine, but only *Microsoft Windows/386* will take advantage of the processor's 386-level capabilities.



programs can access memory beyond the 640K limit. *QEMM-386* saves the PC owner the expense of purchasing special EMS 4.0 memory boards in order to enjoy the benefits of such memory.

Qualitas's *386-to-the-Max* supports both remapping of BIOS ROM and EMS 4.0 emulation and adds another twist of its own: it uses 80386 remapping to replace slower memory in high-volume areas (if any exists there) with faster memory, placing the slower memory in areas that are accessed less often. Finally, by carefully juggling blocks of memory between video RAM and the top of the 1MB limit, *386-to-the-Max* can locate TSRs in upper memory, leaving more of the precious 640K territory for your application programs to use.

DOS ENHANCEMENT SHELLS

While DOS extenders attempt to add value without affecting DOS's interface or the software that runs under it, DOS enhancement shells insert themselves either between DOS and the machine or between DOS and the user to add significant capabilities. DOS is still there, but the DOS enhancer is also there, working its magic in a way that is largely transparent to the software if not to the user.

DOS enhancers allow you to multitask DOS programs. In a single-task operating system like DOS, only one program may execute at a time. To execute another application, you must exit the current one. In practice this is clumsy: suppose that in the middle of working with a large spreadsheet, you need a value from an ASCII file that you have in another directory. Frustrated, you have no choice but to save the entire spreadsheet, exit the program, and bring up an editor to look for the value. Having found it, you must then reverse the process to return to work.

Of course, many programs allow you to "shell out" to DOS—that is, execute a new copy of DOS without ever exiting the program (*Lotus 1-2-3*'s /System command is an example). For very simple problems this is useful, but by the time a new copy of DOS is loaded on top of the base program still in memory, there is generally not enough of the 640K of memory left to do anything. This is the main reason for the popularity of TSR shells like *SideKick*. These TSRs allow the user to pop up a smallish set of tools, such as an ASCII editor, without disturbing work in progress.

With multitasking, however, you can execute more than one application at a time. Although only one program has control of the CPU at any given instant, the operating system passes control back and forth between them fast enough so that they all appear to be executing simultaneously. This can make using the computer a lot more efficient. Now, when you need a value from another application, you can leave the spreadsheet in place and switch over to the new application. Both continue to be active, so the spreadsheet remains just a couple of keystrokes away. Multitasking also lets you get real work done during those long and boring downloads.

Multitasking is very difficult to achieve on an 8086 microprocessor because of the chip's 640K memory limit and its inability to create virtual machines. All of the programs currently executing must be loaded into RAM. Load a single large application, however, and there isn't room left for anything else. Memory mapping on the 80386 allows DOS enhancers to get around this problem. Each program is alloted its own chunk of physical memory up to the 640K limit imposed by DOS. You can make effective use of all available RAM, even if each individual program is limited to 640K.

Microsoft Windows and *DESQview*, which emerged in response to the Macintosh, sit atop DOS and allow you more control. While *Windows* is graphically based, *DESQview* uses a less visually striking but much quicker text-based interface. Unlike these two, *VM/386* was first written specifically around the capabilities of the 80386.

Of course, making DOS multitask is only half the problem. DOS applications are written expecting that they'll work alone in the host computer. As such, they tend to be very inconsiderate of other programs that might be executing simultaneously, particularly when they write directly to video memory.

Since there is only one monitor screen, *Windows* and *DESQview* divide the single physical display into multiple windows, assigning each program its own. A program that accesses the display through DOS or even the BIOS has its output squeezed into its window. Those programs that write directly to screen memory, however, are impossible to contain within a window. These programs write wherever they like on the display, often overwriting their neighbors' windows.

Windows/386 and *DESQview 386* use the mapping capabilities of the 80386 to assign each unfriendly program its own virtual video display along with its allotment of memory. Writing to video memory causes no problems, since each program gets its own. The shell periodically transfers the different virtual displays onto the real physical display, this time being careful to keep each within its window boundaries.

Collisions may also occur over other external devices. This is much less of a problem, since almost all programs tend to access these devices in a controlled fashion, either through DOS or at least via the BIOS. Programs that access the hard disk controller directly, for example, are rare and very dangerous and definitely not candidates for multitasking.

◆

When DOS is removed from the equation, compatibility becomes a real issue.

◆

Like the other DOS enhancement shells, *VM/386* uses a mode of the 80386 known as Virtual 86 mode to construct multiple virtual 8086 PCs all executing simultaneously within the same real 80386-based PC. Once you have started *VM/386*, you can create as many virtual PCs as memory allows. These virtual PCs are completely separate. You can even reboot them independently.

VM/386 makes no attempt to reconcile output from the different virtual PCs into windows. Each virtual machine executes with its own virtual video adapter. Only one has control of the real adapter, and only it is visible on the display. Switch to another virtual 8086, and *VM/386* makes it the visible session. In addition, *VM/386* does not attempt to keep programs from arguing over external physical devices. If two or more virtual machines decide to print at the same time, the mixture of characters becomes nothing more than a study in time-sharing.

DOS-COMPATIBLE REPLACEMENTS

DOS enhancement shells retain as much DOS compatibility as possible by retaining as much of DOS as possible, but this also complicates their lives. Not only must these shells handle applications that expect to own the hardware themselves, but they must also stay on guard to protect an operating system that does not expect multiple applications either. At some point, it becomes easier to discard the DOS kernel and rewrite it in a multitasking version.

DOS-compatible replacement operating systems retain no part of DOS. Instead, these operating systems are based upon kernels that have been rewritten using multitasking design concepts. With only the applications to worry about, DOS replacements are in a position to do a better job of multitasking. These replacements even support multiple users simultaneously via serial terminals.

When DOS is removed from the equation, compatibility becomes a real issue. Most of DOS's features are well documented, but there are some that are not. Software that attempts to access a DOS feature that is not supported in the replacement will not execute properly. This is true even if the "feature" is in fact a bug.

The two most popular of these replacement operating systems are The Software Link's *PC-MOS/386* and Digital Research's *Concurrent DOS 386*. Like *VM/386, PC-MOS* is a new product designed around the 80386 (even though it doesn't use the 32-bit power of the chip). By comparison, *Concurrent DOS 386* represents the continued evolution of Digital Research's Concurrent DOS operating system.

Interestingly, the operating system kernel upon which these DOS replacements are based does not have to be DOS-compatible itself. For example, Unix has been used as a kernel for DOS-compatible

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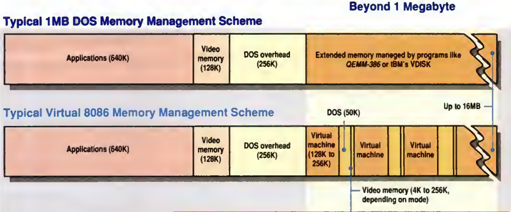
Making Room to Multitask

In a typical single-tasking DOS environment, the first 640K of RAM is reserved for DOS essentials (about 50K) and applications. The memory immediately above 640K is devoted to video memory, as little as 4K for monochrome systems, up to 128K for EGA and 256K for VGA systems. Any memory beyond 1MB is extended memory and is usually controlled by a special memory manager program.

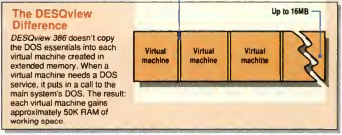
In virtual 8086 mode—the feature of the 386 processor that multitasking programs rely on to split memory into virtual machines—the first 1MB of RAM is allocated the same way.

Beyond 1MB, however, multitasking programs divide the memory into any number of virtual machines, each normally from 128K to 256K in size. Each virtual machine also has a copy of about 50K of DOS basics and its own video memory.

Theoretically, you can fill up to 16MB with virtual machines (if you can afford that much memory), but if that many machines were active simultaneously, performance would be at a crawl. Most multitasking programs do their best work if no more than four virtual machines are active at any one time.


Beyond 1 Megabyte
Typical 1MB DOS Memory Management Scheme
Applications (640K)
Video memory (128K)
DOS overhead (256K)
Extended memory managed by programs like QEMM-386 or IBM's VDISK
Up to 16MB
Typical Virtual 8086 Memory Management Scheme
DOS (50K)
Applications (640K)
Video memory (128K)
DOS overhead (256K)
Virtual machine (128K to 256K)
Virtual machine
Virtual machine
Video memory (4K to 256K, depending on mode)

The DESQview Difference



DESQview 386 doesn't copy the DOS essentials into each virtual machine created in extended memory. When a virtual machine needs a DOS service, it puts in a call to the main system's DOS. The result: each virtual machine gains approximately 50K RAM of working space.

shells. Older than DOS itself, Unix was designed primarily for minicomputers and mainframes. As such, Unix is difficult to host on 8086- and 80286-based PCs, but it feels right at home on the more powerful 80386 (see the sidebar "What About Unix?").

For now, 386 multitasking programs are your best bet for turning your single 386 machine into a deskful of simultaneously running PCs, even if they have yet to take full advantage of the 386 chip. We're still waiting for all the packages to follow the lead of *VM/386* in making simultaneous applications so independent of one another that one crash doesn't bring everything tumbling down.

We also hope to see these programs use the demand-paging capabilities of the 386 chip (using disk space to simulate RAM memory and controlling what is swapped out and back). With a 2MB system, you should be able to run as many applications as you want, even more than 2MB's worth. It might be excruciatingly slow, but it should work. Even the Macintosh implements a crude form of demand paging, and it has no hardware support from the 68000. The 80386 is full of features waiting to be used, and even though these programs are starting to exploit them, they still have plenty of room to grow.

Reviews of the five multitasking programs follow. To test them, PC Labs took an IBM PS/2 Model 80, loaded it with 8MB of RAM (you'll need at least 4MB to do effective multitasking), and set up true multitasking systems with each multitask-

WHAT ABOUT UNIX?

Unix is the most important multiuser operating system available today, but a mature OS/2 may block its migration to office desktops in the 1990s.

Unix offers a multitasking alternative to both OS/2 and the various MS-DOS derivatives. Opinions vary widely, however, on whether Unix poses a serious threat to the eventual transition of most users from DOS to OS/2.

On the one hand, partisans of OS/2 claim that their system is the natural successor to DOS. They say that even though it will take some time, OS/2 will surely emerge as the dominant operating system on the desktop and that Unix will stay in its niche.

Advocates of Unix point to its established position as the dominant operating system for high-end workstations. In fact, IDC, a market research firm, estimates that at the end of 1987, 76 percent of workstations were running Unix (as opposed to 0.8 percent of the PCs, or 120,000 machines). Unix aficionados boast that as personal computers gain the speed, power, and memory of technical workstations, Unix will spread onto office desktops. To sort out these claims, we must recognize that Unix has played several different roles in the past and may play new ones in the future.

Unix is, first and foremost, by far the most important multiuser standard operating system now and for the foreseeable future. It is the only real alternative to proprietary operating systems like MVS and VM for IBM mainframes or VMS for Digital's VAX computers.

The market for Unix-based multiuser systems is one of the fastest growing today. Unix will certainly continue to be the operating system of choice for newer and more powerful systems built around multiple microprocessors. It is steadily gaining market share against the older proprietary operating systems and seems destined to be a dominant factor in multiuser systems.

Unix has also been used as the operating system for high-end workstations based on the Motorola 68000 family of microprocessors. The large linear address space of the 68000 made it preferable to the earlier Intel chips such as the 8086 and 80286 for workstation developers. Typically aimed at scientific or technical applications, these workstations were Unix-based largely because Unix was already available for the Motorola architecture, having been developed for multiuser systems based on the 68000.

Multiuser Unix systems were typically character oriented, supporting multiple terminals in business applications. They were predominantly multiuser and only incidentally multitasking.

Workstations required fast, high-resolution graphics for only a single user. But since a multiuser operating system like Unix is necessarily multitasking, too, Unix also served as an adequate foundation for workstations. Starting with a Unix base, workstation vendors built sophisticated graphical user interfaces on top of it that were similar to but in some cases more powerful than those of the Apple Macintosh and the DOS and OS/2 Presentation Manager.

SHARP SEPARATION Workstations based on the 68000 could not easily run software for Intel-based IBM and compatible MS-DOS systems. So the DOS PC world and the Unix workstation world were sharply separated by their different architectures. The Intel 80386 processor changed all that because its virtual machine capability makes it possible to run DOS virtual machines in a Unix environment. Innovative workstation vendors like Sun were quick to realize the potential of the 386. By offering 386-based Unix systems that can run DOS under Unix, Sun hopes to capture current MS-DOS desktops that might otherwise go to OS/2.

The powerful graphical user interfaces based on Unix on high-end workstations offer a serious alternative to OS/2 and the Presentation Manager. The growing acceptance of Unix as the definitive standard for multiuser PC-based systems lends additional credibility to the Unix alternative. Nevertheless, OS/2 has many advantages. Unlike Unix, it is designed to be a multitasking single-user operating system. It has a very clean set of interprocess communication capabilities, for example. And Unix still carries a lot of baggage from its multiuser heritage. Those few real advantages that it has over OS/2 (such as a more capable file system) are likely to be short-lived as future versions of OS/2 are released and accepted.

Still, I wouldn't rule out the possibility that Unix may prove to be a winner on the office desktop. That outcome, while not probable, is certainly possible. Should OS/2 have performance problems or prove buggy, should updates be slow in coming, or should IBM and Microsoft have a falling-out over OS/2's future, then Unix might end up a successful dark horse.

Having said all that, I'll still bet on OS/2. OS/2 is where most of the action is for software developers. It's got what it takes for the PC-based world of the 1990s. I don't think IBM and Microsoft are going to stumble in the stretch. Yet unless they do, Unix won't have a much bigger impact on office desktops in the next decade than it did in the last.

—William F. Zachmann

***William F. Zachmann is a contributing editor of* PC Magazine.**

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MULTI-USER QS/2 is multi-tasking but NQT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 32 terminals and modems to connect to any computer.

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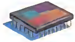
ing program. By running PC Labs benchmark tests on each of the virtual machines created in memory, we learned how these machines perform and how the addition of more virtual machines slows the performance of the whole system. In addition, testing applications with *dBASE III Plus, Lotus 1-2-3, WordStar* 4.0, *Relay Gold,* and *SideKick Plus* exposed some erratic behavior when several of these programs were operating in virtual machines simultaneously.—**Stephen R. Davis**

Stephen R. Davis is a systems programmer based in Greenville, Texas. He is a frequent contributor to PC Magazine *and is the author of* Multitasking Operating Systems and DESQview *(M&T Books).*



Concurrent DOS 386

Think of *Concurrent DOS 386* from Digital Research as a software chameleon. It's a multiuser operating system that makes a workable multitasking environment. It mimics DOS but has its roots in venerable CP/M.

The basic $395 version of *Concurrent DOS 386* allows the simultaneous execution of up to eight programs among up to three users. A $495 version of the operating system supports up to ten users and 22 simultaneous sessions.

Though the software box says that the program can run up to 255 virtual 8086 programs simultaneously, the more realistic number of simultaneous user applications (standard DOS programs that you can run at the same time) is much smaller—in a single-user system, the practical limit is four.

Although *Concurrent DOS 386* is an operating system that can be used without DOS—it will format your hard disk and will even support individual partitions up to 512MB—it can be installed in conjunction with DOS without altering any files you already have installed. During its automatic installation process, it obediently copies itself to an ordinary DOS subdirectory. When your system boots up with *Concurrent DOS 386,* it even gives a special prompt at boot-up time asking whether you want to run it or DOS.

When *Concurrent DOS 386* is active, you can indiscriminately run either DOS or CP/M 86 applications. It executes .CMD, .COM, .EXE, and .BAT files, in that order of preference. In addition, *Concurrent DOS 386* can read, write, and format both DOS and CP/M 86 disks.

Although the system can address any byte within the 4-gigabyte range of the 80386 microprocessor, the full extent of that range is not useful. In fact, a full-blown, single-user multitasking system with four 640K DOS sessions requires only about 2MB. Memory above that can be used solely as expanded memory with applications that can use it. *Concurrent DOS 386* provides its own expanded memory emulation, limited to support for EMS 3.2 and EEMS in the current version of the operating system.

Concurrent DOS 386 treats the four sessions it allows as virtual machines. Each one is given its own blank screen equipped with little more than a system prompt. One session is special in that it operates in the foreground, accepts keystroke input, and by default takes over the entire visible screen. Other sessions lurk in the background, usually invisibly, where they may execute concurrently or just idle along inactively, waiting for their chance in the limelight.

Each session is independent and can run its own applications, even TSR programs. Like a string of old-fashioned Christmas lights, however, when one session goes down, they all go down. You cannot reboot the individual sessions separately.

EASY SHIFTING On the positive side, *Concurrent DOS 386* shifts each one of its four sessions into the foreground with alacrity. Just press Alt and a number on the numeric keypad, and the application assigned to that window snaps on-screen. At the system prompt, *Concurrent DOS 386* uses display line 25 to show you what applications are executing in each of its sessions.

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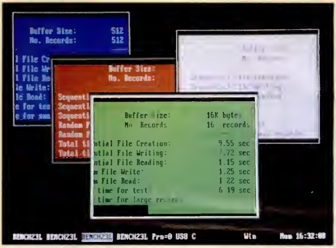

```
Buffer Size:      512
No. Records:      512
```

```
Buffer Size:
No. Records:
```

```
         Buffer  ize:            16K byte
         No  Records             16  records

ntial File Creation:               9.55 sec
ntial File Writing:                 .72 sec
ntial File Reading:                1.15 sec
m File Write                       1.25 sec
m File Read:                       1 22 sec
 time for test                     6 19 sec
 time for large records
```

```
BENCH23L BENCH23L BENCH23L BENCH23L Pro=0 USB C          Wtn      Mon 16:32:00
```

Unlike PC-MOS/386, *the other multitasking/multiuser package we tested,* Concurrent DOS 386 *puts its virtual machines into windows and allows color customization of each window. Across the bottom of the screen are listed the names of the applications running in each virtual machine. The highlighted application is running in the foreground.*

Photographs: Thom O'Connor Illustrations: Roxana Villa

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current DOS 386, each of its sessions can be assigned its own startup file that functions as the equivalent of DOS's AUTOEXEC.BAT file. The overall operating system uses its own version of CONFIG.SYS to load device drivers and configure itself.

Once you've booted *Concurrent DOS 386*, you can run both text and graphics applications as you would under DOS; however, most of the operating system's special features are limited to text mode only. You can run exactly one graphics application, which must execute in the foreground with the entire screen of your display devoted to it.

Text-mode applications can run either using the full screen or in smaller, overlapping windows. Unlike *Windows/386* or *DESQview*, however, windows don't occur naturally with *Concurrent DOS 386*. They must be specifically set up.

To support programs that make calls to the DOS command processor, COMMAND.COM—which is not (and cannot be) part of *Concurrent DOS 386*—Digital Research supplies its own emulation program, CDOS.COM, which (like the setup utilities) must be run before you start any application that would otherwise make a call to COMMAND.COM.

WINDOWING Windowing under *Concurrent DOS 386* requires more system setup using your choice of a menu-driven program, WMENU, or a command-driven program, WINDOW. With either utility you can scale, arrange, and set the colors used by the four *Concurrent* windows on the screen.

Communications between windows or tasks under *Concurrent DOS 386* are limited to exchanging files, but Digital Research does include a utility that captures on-screen information to a file that can be read into other applications. *Concurrent DOS 386* also allows you to interchange files between DOS and CP/M disks. While *Concurrent DOS 386* does not permit direct communication between applications, this can be achieved through a tool kit supplied by Digital Research.

Concurrent DOS 386 has no built-in file-locking scheme of its own and depends on individual applications to manage and secure files from simultaneous access by different tasks. On the other hand, the program lets you password-protect disks, directories, and files.

To bring the multiuser abilities of *Concurrent DOS 386* to life, you can connect up to two serial terminals to your 386 PC. A menu-driven setup program aids in making the connection. Each of the two terminals can run up to two text-mode DOS or CP/M applications. The DOS applications you want to run on terminals must be configured as if to run on a text-only monochrome display because *Concurrent DOS 386* offers no graphics support for terminal-based applications.

Concurrent DOS 386 can handle up to five printers, three parallel and two serial. The real limit is the number of free ports in your system. For instance, if you have a terminal connected to one serial port and a modem to the other, you are limited to three parallel printers. Provisions built into the operating system prevent collisions between print jobs from different applications.

To coordinate the use of printers with multiple sessions, *Concurrent DOS 386* uses a special program called the Printer Manager, which functions in both menu- and command-driven modes. The Printer Manager queues and formats (if you want) up to 254 print jobs to one or more printers. Rather than automatically intercepting the data stream bound for your printer, it works from disk files.

FACT FILE

***Concurrent DOS 386*, Version 2.0**
Digital Research Inc.
Box DRI
Monterey, CA 93942
(408) 646-6464
List Price: $395
Requires: 1MB RAM, 2MB disk space (20MB recommended).

In Short: A multitasking and multiuser alternative operating system that traces its roots to CP/M. It's twice as expensive as the specialized multitasking systems and lacks some of the features that they offer. Background applications tend to pop into foreground. Not copy protected.

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386 Operating Systems: Summary of Features

The following commentary analyzes some of the terms in this table of features.

Multiuser capabilities Each of the operating systems reviewed here is a *multitasking* system, meaning that it can run more than one program concurrently. A *multiuser* operating system can support several users simultaneously. Of course, a multitasking system can also be multiuser.

Allows rebooting individual virtual machines 80386 processing permits operation in real, protected, and virtual 8086 mode. In virtual 8086 mode, individual sessions can be set up that run programs and generally act like stand-alone 8086 machines. (The maximum number of sessions is a function of the operating system and the memory available.) Some operating systems allow the individual virtual machines to be rebooted, as in a software Ctrl-Alt-Del warm boot, without interfering with the operation of the other "machines."

Allows user-customizable time slicing Multitasking takes advantage of the speed of computers by processing instructions in fractions of seconds, or time slices. If, for instance, each slice is 1/18 second, 18 tasks could execute, one after another, in a second of processor time. Some systems allow customizing the allocation of time slices to give more time to important tasks.

Uses DOS COMMAND.COM rather than proprietary COMMAND.COM Some commercial software programs require COMMAND.COM to run. For this reason, most 386 operating systems either provide DOS COMMAND.COM or replace it with a proprietary program.

Also Included Note that all of these operating systems include utilities and device drivers, which are not mentioned in the table.

(Products listed in ascending price order)

	PC DESQview 386	PC Microsoft Windows/386	PC-MOS/386	PC VM/386	Concurrent DOS 386
SOFTWARE COMPATIBILITY	$189	$195	$195	$245	$395
Uses LIM EMS 4.0	●	○	●	○	○
LIM EMS 4.0 driver provided	●	○	○	○	○
Runs under DOS	●	●	○	●	○
DOS version required	2.0 or later	3.0 or later	N/A	3.0 or later	N/A
Separate network version	●	●	●	○	●
Compatible network operating systems	*NetWare, 3+Share*	*NetWare, PC LAN, StarLAN Network Program, 3+Share*	*Lanlink 5X, NetWare*	*NetWare, PC LAN, PCnet, 3+Share*	*DR NET*
Runs under OS/2	○	○	○	○	○
Runs with IBM BIOS	●	●	●	●	●
Runs with Phoenix BIOS	●	●	●	●	●
Runs with Award BIOS	●	●	●	●	●
Runs with other BIOS	●	●	●	●	●
OPERATIONAL FEATURES					
Maximum number of windows	255	Limited by expanded memory	N/A	N/A	4
Cut-and-paste feature	●	●	●	○	●
File sharing between tasks	●	●	●	●	●
Password protection	○	●	●	○	●
Multiuser capabilities	○	○	●	○	●
Maximum number of users	1	1	25	1	10
Maximum number of concurrent sessions	255	Limited by memory	Limited by memory	32	22
Allows rebooting individual virtual machines	○	○	○	●	○
User-customizable time slicing	●	○	●	●	○
Print spooler	○	●	●	○	●
File locking	●	○	●	●	○
DOS FEATURES					
Allows simultaneous DOS use	●	●	●	●	○
Allows simultaneous OS/2 use	○	○	○	○	○
Replaces DOS	○	○	●	○	●
Uses DOS COMMAND.COM rather than proprietary COMMAND.COM	●	●	○	●	○
Allows standard DOS commands	●	●	●	●	●
Reads and formats DOS disks	●	●	●	●	●
ALSO INCLUDED					
Automatic installation routine	●	●	○	●	●
On-line help	●	●	●	●	●
Context-sensitive help	●	●	○	●	●
Indexed documentation	●	○	●	●	●
Tutorial	●	●	○	●	●
Free technical support	●	●	●	●	●(90 days)

PC—Editor's Choice ●—Yes ○—No

N/A—Not applicable: product does not have this feature.

Although you can use *Concurrent DOS 386* to give your 80386-based PC multitasking abilities, it's at its best when used simply to shift between sessions devoted to a full screen. Not only is its windowing confusing for the casual user, but it also does little to protect the screen from the intrusion of background applications. Especially missed is the ability to virtualize video memory (and so keep programs with ill-behaved video under control), which is promised for Version 3, due out soon.

SHARING RESOURCES When it comes to sharing system resources, *Concurrent DOS 386* is strictly a time-slicing system that devotes 1/60 of a second to each of its applications before moving on to the next. The division is equal among executing applications, so filling all four windows with running programs cuts performance by about 75 percent.

◆

As a multitasker, *Concurrent DOS 386* is strictly a time-slicing system.

◆

As shipped, *Concurrent DOS 386* doesn't even suffer that amount of degradation. Although sold as a multitasking system, straight from the box it does only context switching. When you switch a program into the background, *Concurrent DOS 386* defaults to suspending its operation. To keep a program running in the background, you must issue a specific SUSPEND=OFF instruction in the window in which you want to run the application.

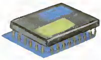
Keeping background applications turned off hides one of the bigger shortcomings of *Concurrent DOS 386:* that *Concurrent* does not do a very good job of protecting the foreground display from ill-behaved applications that write directly to video memory.

This inept screen handling changed real-world use of *Concurrent DOS 386* into a travesty during testing. Whenever *Lotus 1-2-3* was set calculating in the background, it would punch through whatever application was on top. First one cell would appear, then another, then maybe a whole block until the screen was obliterated by an unresponsive spreadsheet: although the screen was pure *1-2-3*, the controls remained with the foreground application. The only way to discern how slow the system became when *1-2-3* barreled along in the background was to note errant cells poking through more lackadaisically.

Other applications were bothersome but not quite as unusable in the background. For instance, *WordStar* printed in an unseen session without making its presence known (other than for slower system response) until it finished. Then a block from *WordStar* would punch through as its invisible background screen was updated to show that printing was done.

With well-behaved applications running in the background, the linear degradation of the system's response was readily apparent as tasks were heaped on. By the fourth application, the 80386 test system seemed as sluggish as a standalone XT. In fact, in PC Labs testing, *Concurrent DOS 386* was among the slowest of the environments tested.

If you want the DOS and CP/M features of *Concurrent DOS 386,* you may want to keep its SUSPEND feature on and use it chiefly as a context-switching environment. For true multitasking, you'll find more features, lower prices, and easier use elsewhere.



DESQview 386

DESQview 386 is the combination of two Quarterdeck Office Systems products: *DESQview* (Version 2.2) and *QEMM-386* (Version 4.2). But the $189 *DESQview 386* is more than a simple sum of its parts, and it rates as one of the top 80386-based operating environments.

DESQview itself is an operating environment that permits several standard DOS applications to run simultaneously, one in the foreground and the rest hidden in the background or in on-screen windows. Thus, *DESQview* stands out among 80386 environments in that it does not require an 80386 microprocessor and can multitask on any system. On unadorned PCs and ATs, only the DOS 640K area can be used for true multitasking, but the addition of an EEMS or fully supported LIM 4.0 board will let even non-80386 systems run megabytes of programs at once.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

DESQview 386
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
List Price: $189

Requires: 640K RAM, 300K disk space, DOS 2.0 or later.

In Short: A text-based, multitasking DOS enhancer that is simple to install and operate. Behaves well with most DOS applications and maintains its speed fairly well under heavy program loads. An excellent mainstream tool. Not copy protected.

CIRCLE **696** ON READER SERVICE CARD

QEMM-386 is an expanded memory manager for 80386 microprocessors that eliminates the need for special memory hardware, converting ordinary extended memory into the enhanced expanded memory that *DESQview* uses for its multitasking. In addition, *QEMM-386,* which sells alone for $59.95, can add ROM shadowing to systems that lack it, extend the DOS memory area, and run TSR programs outside the DOS 640K range.

The *DESQview/QEMM-386* pair can handle up to 255 simultaneously executing applications, but the more practical limit of the package is the nine-window maximum it can display on the screen. The real limit on what you can do with *DESQview* is based on the amount of system memory you can afford.

Each window in *DESQview* gives a look at an independent virtual machine. Windows overlap, and you'll notice that applications can be completely buried

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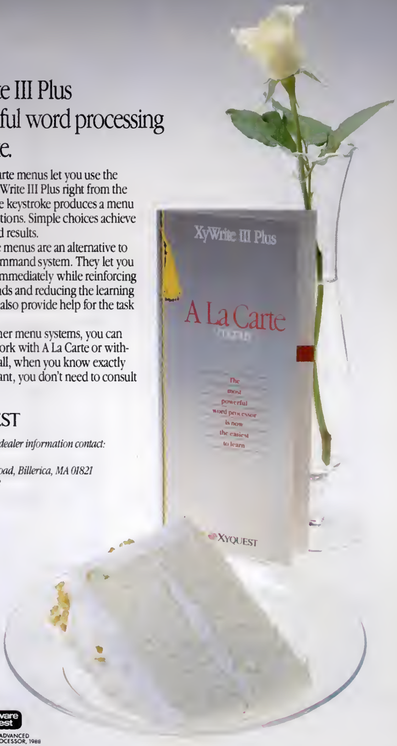
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PERSONAL COMPUTING TOP

PC MAGAZINE EDITORS' CHOICE

Software Digest
#1 RATED ADVANCED WORD PROCESSOR, 1988

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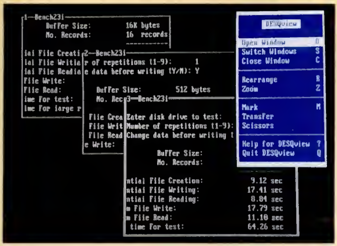

```
1—Bench23i
     Buffer Size:           16K bytes
     No. Records:           16  records
                            ----------
ial File Creati 2—Bench23i
ial File Writin r of repetitions (1-9):      1
ial File Readin e data before writing (Y/N): Y
File Write:
File Read:          Buffer Size:        512 bytes
ime for test:       No. Rec 3—Bench23i
ime for large r
                 File Crea Enter disk drive to test:
                 File Writ Number of repetitions (1-9):
                 File Read Change data before writing t
                e Write:
                                Buffer Size:
                                No. Records:

                           ntial File Creation:          9.12 sec
                           ntial File Writing:          17.41 sec
                           ntial File Reading:           8.84 sec
                           m File Write:                17.79 sec
                           m File Read:                 11.18 sec
                            time for test:              64.26 sec
```

DESQview 386 *is one of the three programs we evaluated that gives you windows into all the virtual machines you've created as they are running. Control of the windows is handled by a simple menu that includes some of* DESQview*'s cut-and-paste functions and on-line help.*

while they continue to execute.

DESQview 386 requires only about 300K of disk space for the program and all its accompanying support. In operation, the system is even more compact. *QEMM-386* steals only 1.5K of conventional RAM. *DESQview* itself now imposes only 10K of overhead on each of its virtual machines, invisibly stealing about 65K more from the extended addressing area; it's the only multitasker that accomplishes that trick.

STRETCHING MEMORY *DESQview* helps you get more from the memory in your system by sharing DOS between memory partitions. That is, you need only one block of physical RAM for any number of copies of DOS running in your system. All partitions address this same physical memory when using DOS code. However, this DOS area is mapped into each partition, and its size must be subtracted from the 640K of memory that's useful to programs.

One of *DESQview*'s hallmarks is its ease of installation and operation with most applications. Both *QEMM-386* and *DESQview* itself include automatic installation programs that merely require you to answer a few questions. *DESQview* automatically searches your hard disk for applications it knows about and sets itself up to operate them within windows whether the programs are well- or ill-behaved.

Once loaded, *DESQview* runs in the background, ready to pop on the screen with a press of the Alt key. Almost instantly, an initial menu pops out on the upper right of the screen; another keypress will open a window and start an application. An additional keystroke may be required to pop another application into the foreground or execute an internal *DESQview* function. The system is easier to use than DOS and is entirely menu driven using moving bars that you select with cursor keys, a mouse, or the first letter of a command.

To make *DESQview* even simpler to manage, you can start it automatically from your system's AUTOEXEC.BAT file, then use *DESQview*'s own script system to load and run applications in its multiple windows. *DESQview* scripts are essentially keyboard macros that the environment memorizes in a learn mode, transcribing your keystrokes to play back whenever you want. You designate one script to execute when *DESQview* is loaded and assign a startup script to each window. For example, you can have *DESQview* automatically poll an e-mail system, pull out data, dump it into a spreadsheet, and graph the results.

Graphics used to throw earlier versions of *DESQview* for a loop. Almost any program that played with individual pixels had to either commandeer the entire screen or humbly spin its wheels in the background. *DESQview* now virtualizes the memory devoted to any standard video adapter all the way up through VGA.

Although still primarily text-based, *DESQview* now allows graphics applications to appear in windows. Switch from text-only displays to mixed text and graphics, and *DESQview* converts the whole screen to graphics mode and simulates text mode where appropriate. Operations slow down somewhat, and colors may take on an odd look with some archaic display systems (for instance, CGA), but it works.

DATA INTERCHANGE *DESQview* allows data interchange between its windows using an elaborate cut-and-paste system that lifts information from the screen displayed by one window and types it into another, even reformatting the data along the way. This feature, together with *DESQview*'s built-in auto-dialer, lets you automatically call any phone number you can display on the screen.

Programs written with *DESQview*'s own application interface can share data by exploiting a more sophisticated "Scissors" mode, which preserves both the content and the structure of information when it is transferred between windows. (*DESQview* offers several utility programs that take advantage of this feature.) Files can also be shared between windows when the need arises.

While *DESQview* allows the use of multiple printers—and different windows can output to different printers concurrently—print jobs are not protected from one another. If two *DESQview* applications try to use the same printer simultaneously, the data streams will tangle into an indecipherable mess.

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When tied into an existing LAN, it eliminates printing delays, supports multiple printers from a single port and permits you to share printers more effectively.

Additionally, FocalPoint Plus provides mailmerge and multicopy capabilities as well as Resource Net, a sophisticated message/mail function allowing instructions, requests or notes to be sent to a mailbox for viewing or printing.

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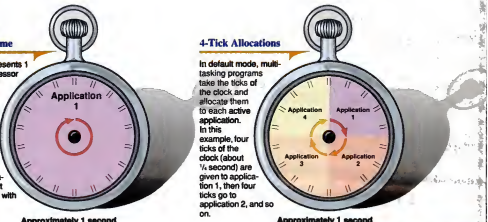
Slices of Time



1 Second of Processor Time

This clock represents 1 second of processor time. A normal clock tick is 55 milliseconds, so about 18 of them pass per second. With no multitasking, the foreground application is the only application and needn't share the clock with anything else.

Approximately 1 second

4-Tick Allocations

In default mode, multitasking programs take the ticks of the clock and allocate them to each active application. In this example, four ticks of the clock (about ¼ second) are given to application 1, then four ticks go to application 2, and so on.

Approximately 1 second

Turning one 80386-based PC into two, three, four, or more virtual 8086 machines requires some complex manipulation of the 386's processing power. Time slicing lets several applications share the processor simultaneously; a multitasking program's time-slicing method determines how the virtual machines will perform and how severe the overall speed degradation will be as more virtual machines are created in memory.

DESQview supports only two serial ports, and potential conflicts are left for you to manage. Though *DESQview* is designed to allow the background operation of communication programs, you cannot swap software that uses a serial port out of active memory.

A new feature to this latest version of *DESQview* gives you a choice of four levels of protection for ill-behaved programs, selected on a program-by-program basis. Each greater level of protection traps more errors and slows performance while offering greater security against conflicts and crashes.

When an error occurs, you're given the choice of continuing, terminating the application, or rebooting the system. Tread warily if you choose Continue; the selection crashed a test system when running a display benchmark program. *DESQview* windows are not individually rebootable (Ctrl-Alt-Del typed in a window will eliminate the window).

DESQview is written only with 16-bit instructions (so it can be compatible with 8088 and 80286 machines), but it can pass along 32-bit instructions to your 80386. For instance, you can run *Paradox 386* in conjunction with *DESQview* (if you have an 80386 machine).

TIME SLICING When you start multiple programs running concurrently, *DESQview* operates as a time-slicing multitasking system. The factory default gives extra weight to the foreground application to improve system response. Normally, five ticks (each one 1/18.2 seconds, or 55 milliseconds, long) are devoted to the foreground activity and three to each background task. You can alter the ratio between foreground and background time by using the advanced features menu of *DESQview*. Background operation also can be completely suspended.

When equal time is given to all applications, *DESQview* performs slightly more slowly than other 80386 multitasking environments but still substantially faster than the operating systems, particularly when heavily loaded. In testing, it degraded to about half speed when it was loaded with two executing applications. Additional tasks did not add substantially to the apparent slowdown.

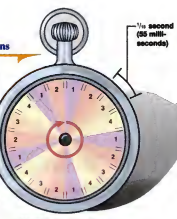
Running real-world applications, *DESQview* had a high-performance feel as long as we stuck with text mode. Its windows snapped right onto the screen. The handling of the actual application screens was not as smooth—fast scrolling of text screens appeared jerky even when only one application was active.

DESQview encountered further problems keeping track of the cursor mode. The cursor changed color, blinking rate, and even position several times as windows were switched. Most of the time it ended up as a flashing bar halfway up the character cell.

When *DESQview* switched into graphics mode to allow a bit-mapped application

1-Tick Allocations

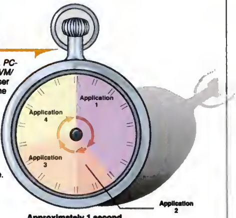
Other multitasking packages alternate between applications tick by tick. In programs that display several applications in windows, this kind of time slicing makes performance look smoother, though somewhat slower. Still, each application is given an equal amount of processor time.



Approximately 1 second

Customized Time Slicing

DESQview 386, *PC-MOS/386*, and *VM/386* allow the user to customize time slicing so that applications needing more processing time can have it, even while other applications are simultaneously active.



Approximately 1 second

How can you see the effects of time slicing in action? *DESQview 386* defaults to time slices of about 1/18 second (seen most clearly in the third clock above). *Concurrent DOS 386* defaults to much smaller time slices of about 1/60 second. As a result, *DESQview 386* works in short bursts that appear fast but inconsistent, while *Concurrent DOS 386* seems slower but smoother in operation.

to share the screen with one written in text mode, some not-so-subtle changes affected the image. The VGA test system shifted from 400-line text mode to 480-line graphics mode—the equivalent of 30 text lines on the screen—making both the text and graphic applications appear squashed. The aspect ratio of the graphics appearing in the window changed from 1.33 to about 1.5. In addition, response time also slowed considerably as the environment incurred the extra overhead of converting the text to graphics mode.

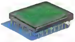
Forty-column text mode would appear only as a full-screen image. Attempting to put 40-column text in a window caused *DESQview* to mask the screen. During one of these trials, the graphic image could not be retrieved from the gray.

DESQview attempted to keep the cursor or screen activity in a visible part of each window, scrolling the application behind the window horizontally or vertically as necessary. When small background windows peeked out to show applications that wrote to various places on the screen—such as filling in random *1-2-3* cells—the image in the window shifted back and forth in a way that was both reassuring and distracting.

When a repeated series of calculations was carried out on one or more copies of *1-2-3* or BASIC, the multiple-tick-based time slicing of *DESQview* became apparent. The calculations were carried out in discernible bursts. Nevertheless, data input to the foreground application appeared unaffected by this intermittent operation, and the foreground program accepted characters smoothly no matter how many applications were simultaneously executing in the background.

Most of the oddities observed while running *DESQview* occurred in modes that would probably not be used in business (for instance, 40-column text). Overall, the environment was well behaved.

DESQview ranks among the most mature multitasking environments available with excellent support for a wide variety of DOS applications. If you stick with mainstream programs, *DESQview* can actually simplify your life while letting you wield real multitasking power.



Microsoft Windows/386

Microsoft Windows/386 is the pinnacle of development for Microsoft's graphics-based operating environment. It brings together point-and-shoot control, pull-down menus, and the ability to run applications written specially for *Windows*, as well as standard applications that run merely under DOS. *Windows* will operate with DOS versions between 3.1 and 4.0 inclusive.

As the name of the $195 program implies, *Windows* divides both the screen and

MULTITASKING WITH A 286

386-based PCs aren't the only ones that can split themselves into several little PCs. Given the right assistance, your 286-based machine can achieve a certain level of multitasking, too.

Although you can't squeeze all the features of an 80386 from a PC based on an 80286 microprocessor, you can get a taste of multitasking by exploiting the advanced features of many programs, special operating environments, and hardware add-ons. At far less cost than buying an 80386-based computer, you can make your PC do two or more things at once—or at least seem to. Here are some of the alternatives:

EXPLOIT SOFTWARE FEATURES The easiest way to start multitasking is to exploit the power of the software you already own. A growing trend among better commercial applications is an option to run a program from within a program, typically by "shelling out" to DOS. The programs exploit a feature of later versions of DOS to create an environment within an environment by running a second copy of the command processor shell, COMMAND.COM.

Although this mode of operation does not permit true multitasking—the underlying application puts one task on hold while you shell out to the new one—it does permit you to leave one task for another and return to the exact place where you left off, an ability called context switching. The penalty you pay is in memory. You'll have two programs loaded at once, both vying for the limited 640K resources available to DOS.

TSR UTILITIES A wide variety of terminate-and-stay-resident (TSR) utilities permit the same context-switching abilities with a couple of advantages. With TSR programs like Borland's *SideKick*, you need make only a keystroke or two to switch contexts, popping in and out of the resident utility. You can even load several TSR programs and shift between them with a few keystrokes.

In addition, most TSR programs and their data remain unchanged in memory even as you load and unload other applications at the DOS prompt. Every time you switch into the TSR utility, you can be exactly where you left off before. Or you can hold data in the TSR program as you change the underlying application, allowing you to move data between different applications.

The principal problem with TSR programs, background utilities, and context switching is RAM cram: both the program you put on hold and the TSR utility remain lodged in memory. As with shelling out of a program, you need enough RAM to accommodate both the underlying application and all the TSR programs you load. Worse, TSR programs can conflict with one another, preventing their simultaneous use.

SOFTWARE CAROUSEL Another way to have context switching is through programs specifically designed to supply it. Preeminent among these programs, *Software Carousel* from SoftLogic Solutions also solves some of the RAM drain because it can save your inactive applications and your place in them in extended, expanded, or virtual (disk-based) memory. The program allows you to shift from one DOS application to another at the press of a key, always keeping your place when you switch back. Contact SoftLogic Solutions Inc., 1 Perimeter Rd., Manchester, NH 03101; (800) 272-9900, (603) 627-9900. **List Price:** $79.95. **Requires:** 128K RAM (256K recommended); DOS 2.0 or later.

BACKGROUND PROCESSES True multitasking is more difficult to achieve because the control program must do more than move dead code around—it has to track several executing program threads simultaneously while constantly guarding against their interfering with (or attacking) one another. With the 80286 microprocessor the problem is more difficult than with the 80386 because the older chips leave memory management and other troublesome issues to the control program rather than handling them in hardware.

One way around the problem is to delegate the responsibility for controlling background operation to the application itself. Such background processes take advantage of the same DOS facilities as TSR programs but use them to different effect. They actually execute invisibly, without demanding your attention. One good example is *Lotus Express*, which handles the sending and receiving of your electronic mail while you work on your other applications. Of course, this technique requires that the programs be specially written for invisible background operation; it won't help if you want to use your favorite DOS application in the background.

DOUBLEDOS One minimalist means of multitasking standard DOS applications is *DoubleDOS* from SoftLogic Solutions. As its name implies, *DoubleDOS* lets you run two independent DOS sessions on your PC using extended or expanded memory so that it can supply adequate amounts of RAM to each. Although it doesn't give you frills like windows, you can run a compiler out of sight while you edit your next programming opus. Contact SoftLogic Solutions Inc., 1 Perimeter Rd., Manchester, NH 03101; (800) 272-9900, (603) 627-9900. **List Price:** $69.95. **Requires:** DOS 2.0 or later.

DESQVIEW Regular *DESQview* (without the 386 appellation) expands further on the capabilities of *DoubleDOS*. With well-behaved applications, it can give you true multitasking on an ordinary PC, working within the limits of its memory. With hardware support from an Enhanced Expanded Memory Specification or LIM 4.0 board, it can break the 640K barrier and juggle several executing DOS applications simultaneously. The shortcomings of using *DESQview* on a computer without an 80386 microprocessor are small—you lose some of the isolation between tasks and may be forced to shut down some less well-behaved background operations. Contact Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405; (213) 392-9851. **List Price:** $129.95. **Requires:** 640K RAM, DOS 2.0 or later.

MICROSOFT WINDOWS 2.0 *Windows* 2.0 can also give you a multitasking environment operating on any PC with sufficient memory. However, unlike *Windows/386, Windows* 2.0 allows true multitasking only with applications that are specifically written to its own software standard or that approximate it through good behavior. *Windows* 2.0 can be used effectively to create a context-switching environment with almost all DOS applications. Contact Microsoft Corp., 16011 N.E. 36th Way, Box 97017, Redmond, WA 98073; (206) 454-2030. **List Price:** $99. **Requires:** 2MB RAM, DOS 3.1 or later.

OS/2 A true multitasking operating system, OS/2 was designed from scratch to execute multiple applications at a time. Unfortunately, OS/2 is very different from DOS and requires not only an 80286 or 80386 microprocessor but also its own specially written programs to take advantage of its features. Its only concession to DOS is its compatibility box, which acts much like a single-user DOS computer and runs most DOS applications (including some ordinary DOS multitasking environments). Contact your local authorized IBM dealer. **List Price:** $495. **Requires:** hard disk with 5MB available space.

ALL CHARGE CARD If software doesn't seem like the right solution for you, you can sidestep some of the hardware deficiencies of the 80286 with specific add-ons for your system. By installing the ALL ChargeCard, you can endow just about any 80286-based computer with the paged-memory abilities of the 80386. Although by itself the ChargeCard won't endow your 80286 with multitasking capabilities, it will allow you to run *PC-MOS/386* on your 80286 using a special driver (supplied with the ChargeCard but developed by The Software Link). Contact ALL Computers, 21 St. Clair Ave. East, #203, Toronto, Ontario, Canada M4T 1L9; (416) 960-0111. **List Price:** $399.

EXPANDED MEMORY Another hardware alternative is to add an expanded memory board to your 80286-based PC. These paged memory boards incorporate their own memory management hardware. By paging blocks of memory into the real addressing range of your microprocessor, these boards let your system address up to 32MB of RAM (under the latest standard). Enhanced Expanded Memory Specification (EEMS) and fully featured LIM 4.0 boards are designed to allow programs to execute in this paged-memory area (older LIM 3.2 boards are not).—**Winn L. Rosch**

EDITOR'S
CHOICE

PC MAGAZINE FACT FILE

***Microsoft Windows/386*, Version 2.1**
Microsoft Corp.
16011 N.E. 36th Way
Box 97017
Redmond, WA 98073
(206) 882-8080
List Price: $195

Requires: 1MB RAM, 2MB disk space, DOS 3.1 or later.

In Short: A smoothly operating, multitasking DOS enhancer that is hampered only by slow video response. Best for *Windows*-related applications like *Microsoft Excel* and Aldus's *PageMaker*. Its menus and windows are slick and easy to operate. Should be used with a mouse. Not copy protected.

the underlying 386 system into partitions that act like windows into virtual machines (*Windows/286*, which first shipped in November 1985, costs $99).

According to Microsoft, you'll need at least 1MB of RAM to get *Windows/386* running, and at least another megabyte to execute four 640K applications simultaneously. A typical installation will require about 1.75MB of hard disk space.

Note that *Windows/386* cannot make use of the virtual memory or demand-paging capabilities of the 80386, which simulates RAM using disk memory. If your system does not have sufficient RAM, you will bump into warning messages that prevent you from loading additional applications.

Windows/386 uses the conventional and extended memory in your system and ignores expanded memory. The environment itself converts some of the extended memory available to it to LIM 4.0 memory that can be used by applications. You can specify the amount, if any, of extended memory used for this conversion.

Each standard DOS application that you run under *Windows/386* is given its own virtual machine with up to 640K of memory assigned to it. As in a real computer, however, some of that space must be shared with DOS. To conserve memory, you can assign less than 640K to each memory partition.

Applications that are specifically writ-

All these programs

have one thing in common:

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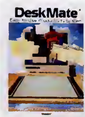

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User Interface by Tandy

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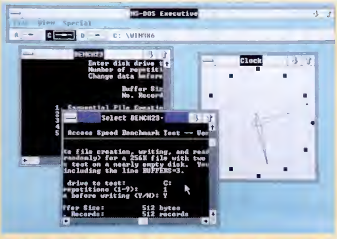

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      No. Record

1  Sequential File Creatio
2
3
4
5
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 Access Speed Benchmark Test -- Ver

te file creation, writing, and read
randomly) for a 256K file with two
 test on a nearly empty disk.  You
including the line BUFFERS=3.

 drive to test:           C:
repetitions (1-9):        1
 before writing (Y/N): Y

ffer Size:           512 bytes
. Records:           512 records
```

Like DESQview 386 *and* Concurrent DOS 386, Microsoft Windows/386 *displays the action of each virtual machine in its own window. As you multitask, the familiar* Windows *interface remains the same. Extras like the clock can be called to the screen, and each item can be moved and sized appropriately.*

ten for the *Windows* environment (either *Windows* 2.0 or *Windows/386*) can take advantage of all the advanced features built into *Windows*. These programs, which include former Editor's Choices *Microsoft Excel*, Aldus's *PageMaker*, *Micrografx Designer*, and Micrografx's *Graph Plus*, share a single virtual machine, breaking through the 640K limit by means of the expanded memory provided by the environment.

ODD RESULTS *Windows/386* is compatible with TSR applications but requires that they be run from within a window. Although you can execute programs like *SideKick* before starting *Windows*, you're apt to get odd results. When run from within a window, TSR applications are available only when that window is in the foreground, removing some of the immediate pop-up-ability that makes most people favor such applications.

Microsoft does not believe that this situation is a problem, particularly since *Windows/386* boasts many utilities that duplicate the function of popular pop-up programs. Included are a calendar, a notepad, a reduced-function word processor, a calculator, a small database, a clock, and a paint program. The *Windows/386* package also features a disk-caching program, SmartDrive.

The conversion of *Windows* to the 386 environment is quite successful. Applications running in the multitasking DOS environment of *Windows/386*, even so-called badly behaved programs that write directly to video memory, can be windowed on-screen. *Windows/386* simulates video memory and transfers bytes to real video memory as the displayed window calls for them. Programs that use unsupported modes of these adapters can be run by yielding the full display screen over to them, but they cannot be windowed.

Although *Windows/386* does not allow the virtual machines in each window to be individually rebooted without bringing the whole system down, the system does include a special Terminate function that helps you get back on track when a single application crashes.

Windows/386 allows your tasks to communicate in a number of ways. Because all applications share a common file system, you can share files between applications without a problem. In addition, *Windows* contains a clipboard to move information that one application displays on the screen to another application. To use the clipboard, you merely mark off a block of text from the screen, then make a menu selection to copy it to the clipboard.

Windows/386 allows you to share a single printer among a number of windows or assign individual printers to applications, up to the maximum number supported by system hardware. In addition, a print spooler utility accompanies *Windows*. This spooler works only with applications specially written for the *Windows* environment, managing multiple simultaneous print jobs and preventing conflicts.

SHARING PORTS Serial ports are shared in a slightly different way. Each of the two serial ports that *Windows/386* supports is assigned to one or more individual applications. No subsequent application can use that port until the window assigned to the first application is closed.

Because *Windows/386* is a graphical environment, it requires a display system with graphics capability. The *Windows/386* environment supports most modes of the EGA and VGA video standards (including CGA modes) and works with a number of proprietary display systems using vendor-supplied drivers.

Built into *Windows* are provisions for both keyboard and mouse control. For manipulating windows on the screen, the mouse interface is superior, although the keyboard interface allows quick, trouble-free multitasking. With the mouse you're given great control over each window. By dragging the mouse along, you can move a window anywhere on the screen or change its size and shape. By clicking on the top bar of a window, you can instantly bring it from background to foreground operation. The effect resembles pulling a paper from the bottom of a pile and stacking it on top.

If you use your standard DOS applications straight from the box along with *Windows/386*, each one will fill the screen while it is in operation.

To make ordinary DOS applications (that is, those not written to *Windows*' specifications) run in the background and in windows requires little additional work.

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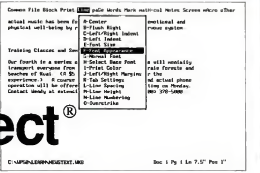

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beaches of Kuai  (A $5    J-Left/Right Margins       r the
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operation will be offere  L-Line Spacing             ting on Monday.
Contact Wendy at extensi  M-Line Height              00) 378-5000
                          N-Line Numbering
                          O-Overstrike

C:\WP50\LEARN\NEWSTEXT.WKB                             Doc 1 Pg 1 Ln 7.5" Pos 1"
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You must set up a program information file (PIF) that contains descriptive information about the program, such as its name as it appears on-disk, the name by which you want to refer to it, any command-line options to use when loading it, and the name of the subdirectory in which it is found. You can set up several PIF files for the same program, each with different parameters.

DIFFERENT APPEARANCES Once you've got your favorite applications running in the graphics-based windows of *Windows/386*, you'll notice a few differences between their appearance there and when they operate normally under DOS.

For example, *Windows/386* tends to shrink text displays vertically, giving them a squashed look. (This effect makes a big-screen display particularly desirable with the *Windows/386* system). The cursor, too, may behave differently, holding steady or flashing slowly and perhaps in an unusual color. During word processing, the slow-flashing, slimmed-down cursor was particularly difficult to find on an ordinary VGA display.

◆

Windows/386 delivers the most polished multitasking system.

◆

Included in the installation options is the ability to load applications automatically when you start *Windows/386* (using the LOAD parameter). You can even start batch files with this option, gaining the flexibility of having the equivalent of a number of AUTOEXEC.BAT files readying your system for you.

One adjustment that is lacking is a provision for changing *Windows*' time slicing. Other than stopping background operations entirely by altering the PIF files of your programs, you have to abide by the prioritizing determined by Microsoft's engineers. Approximately equal time shares are given to each application, foreground or background. *Windows/386* is smart enough not to waste time on programs that are inactive or merely waiting for keystrokes. In PC Labs testing, *Windows/386* proved to suffer minimal degradation with severe loading, both in microprocessor-intensive and disk-intensive scenarios.

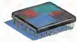
In everyday use, however, *Windows/386* showed some unusual side effects with standard DOS applications. The most disconcerting of these arises from the system overhead required by the system's graphic operation, which affects the apparent responsiveness of the display and the keyboard. Even with only one application active, the screen behaved irregularly. Blocks of characters often popped up several at once rather than smoothly, one at a time as you type them. The effect was even more pronounced when displaying data received through a serial port—whole sentences appeared at once. When four DOS applications were loaded and executing, the display delay became tedious. Applications written for *Windows*, like the Write program included with *Windows/386*, behaved much better, slowing noticeably only under the load of three or four programs.

STRANGE PREOCCUPATION Sometimes, but not always, *Windows/386* became preoccupied with the test communications program. When the program was shifted into the background, a keystroke could take up to 10 seconds to register. At times it seemed the system had crashed, but then a sudden flurry of text would appear on the screen after a considerable delay. Experimentation showed that the problem occurred when the communications program was idling rather than actually dialing, or sending and receiving text.

We also encountered difficulties with programs that admittedly don't use the system timer correctly. For instance, *Crosstalk XVI*'s connection-countdown timer went mad, ticking down 5 seconds for every 1 in the real world when no other applications were running, slowing to half that speed (still two times too fast) with a full program load.

Windows/386 degraded fairly smoothly under increasingly heavy program loads. Adding a second application just perceptibly slowed a recalc on a spreadsheet, but four DOS applications brought the system's thinking to a crawl. *Windows*-based applications did not seem to slow the system as much as DOS programs, perhaps because standard applications require so much overhead to convert their displays to graphics mode.

If you don't mind the staccato typing effect when using standard DOS applications, you'll find that *Windows/386* delivers the most polished multitasking system available for your 80386. It's smooth, quick, and mostly trouble-free.



PC-MOS/386

As a full operating system, *PC-MOS/386*, $195 from The Software Link, is designed to replace DOS. It retains nearly all the functions of ordinary DOS while adding its own multiuser and multitasking abilities. Even with its advance to Version 2.2, however, *PC-MOS/386* remains somewhat buggy and proved itself untrustworthy in testing.

The similarity between *PC-MOS/386* and DOS is, of course, intentional. The nearly identical structure and commands allow experienced DOS users to make an easy transition from DOS to *PC-MOS/386*. Not only does *PC-MOS/386* look and work much the same as DOS, but it will also run most standard DOS applications without a hitch, even in the background.

In addition, *PC-MOS/386* uses the same file structure as DOS and a superset of DOS's disk format, so it can be installed on an existing DOS-based computer without reformatting the hard disk, altering your directory structure, or other such inconveniences. Rather than installing a new operating system, adding *PC-MOS/386* is more like switching to a new operating environment.

Just as DOS 4.0 allows partitions larger than 32MB, *PC-MOS/386* permits hard disk partitions of up to 256MB (with similar problems in backward compatibility).

Benchmark Tests: 386 Operating Systems

PC Labs' multitasking benchmark tests were designed to demonstrate the degradation of foreground processing when one, two, and three background tasks were run simultaneously. The results lifted a few eyebrows.

When the 80386 Instruction Mix benchmark test was run in a loop as one, two, and three background sessions, *VM/386* was consistently fastest with one and two active sessions, but *Microsoft Windows/386* was sometimes fastest with three active sessions (on the instruction mix and memory tests). In fact, *Windows* was faster with three background sessions than it was with two. This phenomenon occurred intermittently with various tests on all the other programs. Eventually we concluded that it was neither a fluke nor a flaw of the operating systems involved. Rather, it reflects efficient use of memory management and time slicing, giving more time to foreground processing and less to background jobs. Note that we always used the default time-slice values when testing these systems, although some systems allow prioritization of tasks or customized time slicing.

These operating systems' manufacturers explained to us how their products optimize memory management. *Microsoft Windows/386*, among the top three on nearly all our tests, gives two-thirds of the CPU to active applications, dividing the remaining one-third among background tasks. Although parts of DOS are copied into each virtual machine, other elements of the DOS environment are loaded only when called by an application program. This reduces virtual-machine memory overhead.

VM/386 uses its SRM (System Resource Manager) to track all the virtual machines, changing the time slicing as required and continually polling for activity. The time-slice algorithm automatically sets the CPU time according to the number of machines being used (unless the user defines the slice). *VM/386* led the pack with the 80386 Instruction Mix running as one and two background tasks. Predictably, *VM/386*, with its built-in 32K disk cache, also won most of the tests involving our I/O-intensive DOS File Access test.

DESQview 386, which was also among the top three in most tests, uses a mix of 32-bit instructions in its *QEMM-386* driver, employing video trapping and memory protection. *DESQview 386* automatically redirects direct memory access to a 2K buffer and achieves fast video scrolling with its BIOS emulation.

80386 Instruction Mix Background Loop

Control results (no background session)

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	3.3	0.6	71.9	7.6
PC-MOS/386	3.3	0.6	79.2	10.8
DESQview 386	3.3	0.6	73.3	7.9
VM/386	3.3	0.7	59.5	2.0
Microsoft Windows/386	3.8	0.8	72.7	8.0

Looping 80386 Instruction Mix in one background session

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	6.7	1.3	106.4	9.2
PC-MOS/386	6.8	1.2	110.7	14.7
DESQview 386	6.7	1.2	140.5	13.4
VM/386	3.8	0.7	58.1	2.7
Microsoft Windows/386	4.6	0.9	85.1	9.2

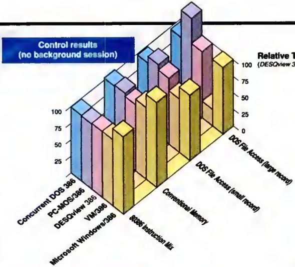
Looping 80386 Instruction Mix in two background sessions

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	10.0	2.0	157.2	16.8
PC-MOS/386	9.9	1.9	160.2	25.0
DESQview 386	6.6	1.2	140.3	13.7
VM/386	4.4	0.9	60.2	1.1
Microsoft Windows/386	5.7	1.1	87.3	9.3

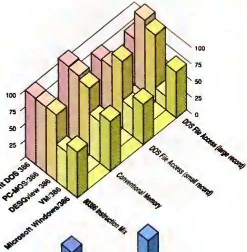
Looping 80386 Instruction Mix in three background sessions

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	16.6	3.1	212.7	10.0
PC-MOS/386	13.3	2.4	207.4	28.5
DESQview 386	6.6	1.2	141.0	13.3
VM/386	5.9	1.2	59.6	2.1
Microsoft Windows/386	5.2	1.0	60.2	8.7

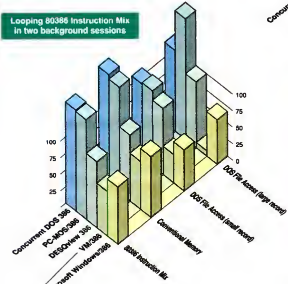
Control results (no background session)

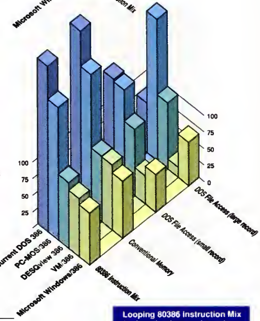


Looping 80386 Instruction Mix in one background session



Looping 80386 Instruction Mix in two background sessions





Looping 80386 Instruction Mix in three background sessions

VM/386 led the pack with the 80386 Instruction Mix running as one and two background tasks.

Microsoft Windows/386 was faster with three background tasks than it was with two.

(continues)

Benchmark Tests: 386 Operating Systems

Testing Procedures

What effect does multitasking have on processing? Do all tasks run at the same speed? Do background tasks interfere with the foreground job? How slow does processing become when one, two, and three tasks are running in the background? PC Labs designed tests to determine the amount of performance degradation that systems suffer as multitasking operating systems process more tasks.

Testing was conducted on an IBM PS/2 Model 80 with a standard 110MB IBM hard disk and 8MB RAM. Multitasking systems were set to default time-slicing specifications, and task memory sizes were set for optimum efficiency according to manufacturers' recommendations. Extended memory and expanded memory were made available for those systems that could use them.

First, each operating system was installed and our benchmark tests were run: 80386 Instruction Mix, Conventional Memory, and DOS File Access for small and large records. This testing yielded control numbers that we could use for comparison.

The multitasking tests involved running one test in a continuous loop. First the 80386 Instruction Mix was reprogrammed to test the processor and write to the screen constantly, thus emulating a busy, processor-intensive application program. With the Instruction Mix loop running as a background task, we ran the regular 80386 Instruction Mix, Conventional Memory, and DOS File Access tests in the foreground.

Next, the **80386 Instruction Mix** loop was set to run as a second background task while the regular benchmark tests were run again in the foreground.

Then we loaded the Instruction Mix loop again, creating a total of three simultaneous background tasks, and once again we tested the foreground. The results demonstrate the degradation of processor speed as more background tasks are added.

The remaining tests followed the same procedure, but with our **DOS File Access** test (small- and large-record versions) running in a loop as one, then two, then three background tasks. As before, we ran the 80386 Instruction Mix, Conventional Memory, and DOS File Access tests in the foreground. The background task emulated an I/O-intensive application and caused measurable degradation on the input/output times.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

DOS File Access Background Loop

Control results (no background session)

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	3.3	0.6	71.9	7.6
PC-MOS/386	3.3	0.6	79.2	10.8
DESQview 386	3.3	0.6	73.3	7.9
VM/386	3.3	0.7	59.5	2.0
Microsoft Windows/386	3.8	0.8	72.7	8.0

Looping DOS File Access in one background session

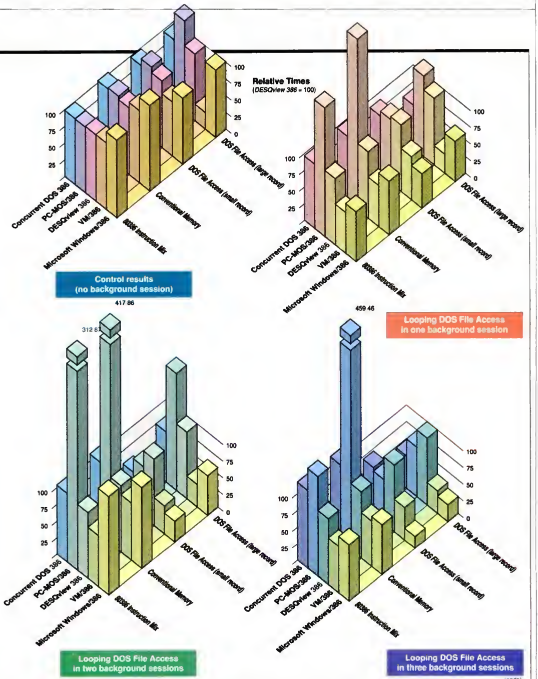
Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	6.4	1.2	165.3	11.9
PC-MOS/386	11.1	3.1	178.4	22.1
DESQview 386	6.6	1.2	186.3	18.3
VM/386	4.1	0.7	121.0	5.3
Microsoft Windows/386	5.0	1.0	96.5	11.0

Looping DOS File Access in two background sessions

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	8.8	1.2	255.9	21.1
PC-MOS/386	18.5	4.7	351.2	49.5
DESQview 386	6.4	1.1	462.0	28.1
VM/386	5.0	1.0	194.5	9.5
Microsoft Windows/386	9.5	1.4	146.3	16.7

Looping DOS File Access in three background sessions

Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)
Concurrent DOS 386	8.9	1.7	412.1	22.1
PC-MOS/386	25.5	6.8	379.6	33.8
DESQview 386	7.6	1.5	576.7	45.5
VM/386	5.4	1.0	282.3	15.4
Microsoft Windows/386	6.5	1.1	103.4	11.6



Control results
(no background session)

Looping DOS File Access
in one background session

Looping DOS File Access
in two background sessions

Looping DOS File Access
in three background sessions

(ends)

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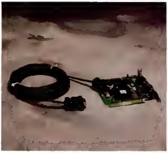

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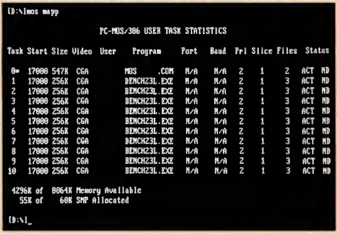
PC NETWORK SYSTEMS



```
[D:\]mos mapp

                       PC-MOS/386 USER TASK STATISTICS

Task Start Size Video  User    Program      Port   Baud  Pri Slice Files  Status

 0*  17000 547K  CGA          MOS     .COM   N/A    N/A   2    1     2   ACT  ND
 1   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 2   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 3   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 4   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 5   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 6   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 7   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 8   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
 9   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND
10   17000 256K  CGA          BENCH23L.EXE   N/A    N/A   2    1     3   ACT  ND

 4296K of  8064K Memory Available
   55K of    60K SMP Allocated

[D:\]_
```

PC-MOS/386's *User Task Statistics screen is the place where you design and control virtual machines. Each machine, or Task, is listed, along with its RAM size, its video mode, its user's ID (for multiuser situations), its current application, and, in the last column, its status (active or waiting).*

FACT FILE

***PC-MOS/386*, Version 2.20**
The Software Link Inc.
3577 Parkway Ln.
Norcross, GA 30092
(404) 448-5465
List Price: $195
Requires: 1MB RAM, 750K disk space.

In Short: A nonwindowing multiuser and multitasking alternative operating system that proved less than dependable in PC Labs testing. Lacks some of the features of specialized multitaskers. Not copy protected.

CIRCLE **694** ON READER SERVICE CARD

The operating system also supports multiple partitions on a single-hard disk without requiring software drivers. In addition, *PC-MOS/386* lets you boot from any hard disk partition, which may be formatted with different operating systems. For instance, you might have three disk partitions—one each with DOS, OS/2, and *PC-MOS/386*—and choose which to boot from.

The standard version of *PC-MOS/386* is designed as a single-user system. Other versions are available to handle 5 or 25 users. Drivers are included to handle 13 different models of serial terminal.

Although originally written as an operating system for 80386-based computers, *PC-MOS/386* has been updated to operate in a variety of other environments. It will even allow multitasking on 8088-based computers, with the restriction of being able to use only real-mode memory (typically only the 640K accessible to DOS), allowing two rather modest 240K sessions to run.

DIVIDING THE SYSTEM Multitasking with *PC-MOS/386* requires that you divide your system into individual sessions that operate as separate computers, taking advantage of the virtual 8086 mode of the 80386 microprocessor. Each session can run one or more programs including TSR utilities. Although *PC-MOS/386* itself cannot use expanded memory, it includes a software driver that converts extended memory to expanded memory (under the LIM 3.2 specification) for use by programs running in individual sessions.

One session always operates in the foreground and can accept keystrokes. All others work in the background. Because *PC-MOS/386* does not support windowing, you can view only one session and task at a time: the foreground session, which occupies the entire screen.

Several means of communication between applications are allowed, including pipelining, semaphores, and emulation of NetBIOS. These techniques will work only with programs specifically written to take advantage of them, however. Most standard DOS applications will be restricted to file sharing for data exchange.

ALLOCATING MEMORY *PC-MOS/386* does not dynamically vary the memory assigned to tasks or sessions. Once you've allocated memory to a session, no other application has access to those bytes even if you don't execute an application in that session. The only way to alter the memory assigned to a session is to explicitly remove the session (with the .REMTASK command) and set it up again with new memory parameters.

One of the more insidious problems with getting *PC-MOS/386* to run several tasks simultaneously is that the procedure is poorly documented. The instructions accompanying the operating system are arranged primarily as a reference guide; this gives no good overview of the steps required. On the positive side, *PC-MOS/386* includes its own help facility.

Most of the routine operations of *PC-MOS/386* are handled by programs bearing the same names and carrying out the same functions as their DOS equivalents—DIR, COPY, DEL, and FORMAT—although The Software Link has added many new commands to deal with the multitasking and multiuser operations of the system. The biggest difference you may notice is the more colloquial response to your errors and transgressions—"What?" instead of "Bad command or file name."

Because *PC-MOS/386* is designed to be a multitasking system, it anticipates that several applications may attempt to use system resources simultaneously. Consequently, it incorporates advanced features like print queuing. The operating system intercepts instructions sent from each ap-

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plication to one or more printers. If two applications try to access one printer, the first one wins and the printer-bound data from the second is routed to a disk-based print spooler.

ROUND-ROBIN SYSTEM *PC-MOS/386* is a strict time-slicing system that defaults to giving each session one system-clock tick (about 55 milliseconds) on a round-robin basis. However, *PC-MOS/386* permits you to alter the length of a time slice, assign different priorities to individual sessions, and deprive idling applications of their time slices.

In the default setup, *PC-MOS/386* degrades rather uniformly, slowing in direct correspondence to the number of sessions with executing programs. That is, with applications running in three sessions, the host computer runs at about one-third its normal speed. Idling programs, like those waiting for a keystroke interrupt, normally do not steal time slices.

In testing, *PC-MOS/386* did a very good job isolating sessions from one another. Even applications that took direct hardware control of the video system were never able to break through the screen to interrupt other sessions. However, the program did demonstrate a few quirks. For example, *Lotus 1-2-3* mysteriously switched to 40-column mode when it was shifted to the background, then back into the foreground. This problem was solved by explicitly configuring the *1-2-3* session as VGA using the operating system's .MOS VMODE command. Other sessions and applications did not show this tendency toward mode switching.

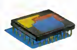
PC-MOS/386 also proved erratic in handling some of the most esoteric hardware features. For instance, the system could not reset the screen border color consistently when reentering a session. Sometimes it would successfully redisplay the border; other times it would not.

Because *PC-MOS/386* does not allow windows, the execution of background tasks is inevitably invisible. However, their effect on system operation is readily apparent. The 55-millisecond time slices result in rather jerky execution of applications. For example, a calculating *Lotus 1-2-3* macro pops cells on the screen several at a time. Instead of filling smoothly, the display refreshes in spurts.

During word processing with a heavy system load, response lagged substantially. Delays of a long fraction of a second were bothersome. Background communications, on the other hand, executed smoothly.

During testing, *PC-MOS/386* revealed bugs that were more than irritating, however. The initial version of the operating system received by PC Labs could not run four benchmark sessions simultaneously. This problem was traced to an interaction of the operating system and the compiler used in making the program, a "red herring" that was unlikely to occur in real-world use, according to The Software Link. The company does have a fix, and it will be sent to current users and incorporated in the next release.

A worse bug was discovered during a word processing session with *WordStar* 4.0. Without warning, the operating system dumped out of the program and went back to the system prompt. The screen displayed an undocumented error message. All work to that point was of course lost. Even if this incident were but a one-time error, *PC-MOS/386* obviously requires more debugging before it is trusted with critical work.



VM/386

As a multitasking operating environment, *VM/386* from Intelligent Graphics Corp. is a tinkerer's delight. Not only does the $245 program allow splitting up your 80386-based computer into as many as 32 independent sessions (the default is 16, but in any case the real limit is available memory), but it also gives you intimate control over the priority assigned to each.

VM/386 divides your computer into two or more virtual machines using the virtual 8086 mode of the 80386 chip. Each machine is isolated from the rest and acts as if it were a dedicated personal computer. Each virtual machine gives you a DOS prompt at which you can run your favorite programs, load in a gaggle of TSR utilities, and even execute software drivers to add-in peripheral devices like mice, displays, or digitizing tablets.

Under *VM/386*, the partitioning between virtual machines is fixed once you've made your setup decisions. Although you can reassign memory at a later time, the environment itself does not dynamically reassign memory between virtual machines as you change the applications running within them. As a result, even if nothing is executing in a virtual machine, its memory cannot be used by the rest of the system.

To get *VM/386* running, you'll need at least 2MB of RAM, which yields at most two 512K virtual machines. Four simultaneous 640K sessions require about 3550K of RAM. You'll also need about 700K of disk space for the *VM/386* files.

VM/386 gobbles up conventional and extended memory but does not use expanded memory. *VM/386* can, however, make extended memory into expanded memory that can be used within its virtual machines. For instance, if you have the RAM available, you can run *Lotus 1-2-3* Release 2.0 in a window with multiple megabytes of expanded RAM for big spreadsheets.

NECESSARY DRIVERS The *VM/386* system includes drivers that can be run within each virtual machine to make expanded or extended memory available to it. The EMS driver supplied with the current version (1.2) of *VM/386* is not LIM 4.0 compatible; however, IGC will supply a LIM 4.0 upgrade to owners of *VM/386*, Version 1.2, on request.

Once *VM/386* is set up, it's easy to use. To switch virtual machines you hold down the Alt key and press the SysReq key (equivalent to the PrintScreen key on an AT-style keyboard) twice. After what seems to be a considerable delay, one that makes you wonder whether your keypresses really took (sometimes more than a second), the screen shifts to another virtual machine.

The switching process works round-robin-style, moving from virtual machine 1 to 2 to 3, then back to 1 in a loop. Pressing Alt and Sys Req once pops up a tiny menu that allows direct access to the VM Manager or any particular virtual machine.

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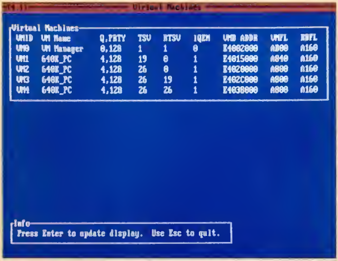

```
[F4.1]──────────────── Virtual Machines ────────────────
┌Virtual Machines──────────────────────────────────────────────────────┐
│ VMID  VM Name      Q,PRTY  TSU  RTSU  IQEM  VMB ADDR   VMFL  RMFL │
│ VM0   VM Manager   0,128   1    1     0     E4002000   A000  A160 │
│ VM1   640K_PC      4,128   19   0     1     E4015000   A040  A160 │
│ VM2   640K_PC      4,128   26   0     1     E4020000   A000  A160 │
│ VM3   640K_PC      4,128   26   19    1     E402C000   A000  A160 │
│ VM4   640K_PC      4,128   26   26    1     E4038000   A000  A160 │
└──────────────────────────────────────────────────────────────────────┘

┌Info──────────────────────────────────────────┐
│ Press Enter to update display.  Use Esc to quit. │
└──────────────────────────────────────────────┘
```

Like PC-MOS/386, VM/386 *has a virtual machine status screen. Each machine is assigned a number and a name. The other columns in the status report, all of which are filled with technical data about the machines' time-slice statases and memory usage, show why* VM/386 *is considered the multitasking system for the technical user who has the time and ability to customize these settings.*

Once you've got the hang of using the virtual machines, you can customize your *VM/386* system to set itself up automatically when you boot your computer. The VM Manager assigns each virtual machine a pair of start-up files equivalent to DOS's familiar CONFIG.SYS and AUTOEXEC .BAT.

Another part of the VM Manager, an advanced features menu, allows you to customize the division of your computer's *VM/386* power. You can choose the time slice allocated to each virtual machine and the priority assigned to each virtual machine's access to system resources such as interrupts. For instance, you might want to assign absolute priority to interrupts serving a communications program so that characters are not lost even when its virtual machine is running in the background.

ALLOCATING RESOURCES The manner in which *VM/386* assigns resources is complicated. Resource allocation happens in a special part of *VM/386* called the System Resource Manager, which is meant to optimize the overall operation of the system. The primary function of the SRM is to shut down background programs that are not active, and in so doing heap the maximum power and response on the foreground application.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

***VM/386*, Version 1.2**
Intelligent Graphics Corp.
4800 Great America Pkwy.
Santa Clara, CA 95054
(408) 986-8373
List Price: $245

Requires: 2MB RAM, 700K disk space, DOS 3.0 or later.

In Short: A nonwindowing multitasking DOS enhancer that creates up to four virtual machines, each independent enough to crash without bringing down the others. More difficult to use than the others, but if you learn to use it, its excellent customizability is its strongest feature. Not copy protected.

CIRCLE **693** ON READER SERVICE CARD

The SRM works by sensing the background task's execution of external interrupts. When no such interrupts occur, the SRM assumes that the task is inactive, perhaps waiting for a keystroke, and shuts it down. Of course, programs involving intense calculating—like a massive spreadsheet recalc or statistical analysis—usually do not interact with external interrupts. Because the SRM is on by default, you may be surprised to find nothing happening in the background when you think you're multitasking with *VM/386*.

Even with the SRM off, you may be as surprised as we were at *VM/386*'s allocation of system resources. After we assigned all virtual machines the same priority when testing in PC Labs, we discovered that background tasks executed at about 1/10 the speed of the one task in the foreground. Although this division of labor makes *VM/386* appear snappy when loaded with many executing applications—and makes its performance look undeservedly good—you'll want to reassign priorities if you're expecting to accomplish a lot of work in the background.

With real-world applications, *VM/386* proved to be a smooth operator. Its relatively brief time slices helped to make *Lotus 1-2-3* calculations appear on the screen with pleasing regularity rather than in bursts, even when the system was heavily loaded with other applications.

When using a word processor, scrolling remained smooth (although slower) as system loading increased. The inordinate amount of time devoted to the foreground session prevented excessively long lags when typing or issuing commands. Although background calculations plodded along at a leisurely pace, the system could handle 1,200-bit-per-second background communication even with four applications running simultaneously.

EXTRA SNAP Another way that *VM/386* earns some extra snap is through its inclusion of a 32K disk cache. A cache is particularly worthwhile in a multitasking system because extensive head movements might be required when alternately reading from the different files each virtual machine uses. The cache helps avoid much of this head movement.

It's always the raw speed of an application that seems to catch one's attention. But when you think about it, speed alone doesn't always determine the amount of useful work you can produce.

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EDITOR'S CHOICE

- ***DESQview 386***
- ***Microsoft Windows/386***
- ***VM/386***

Each of our three Editor's Choices is intended for a different type of user. DESQview 386 *is the choice for the user new to 386 machines and multitasking who wants to set up virtual machines smoothly, run them speedily, and economize on RAM in the process.*

Microsoft Windows/386 *is the natural choice for anyone who spends time working in a graphical environment. If you use* Microsoft Excel, *Aldus's* PageMaker, *or* Micrografx Designer, *all of which have been optimized to run under* Windows, *you'll appreciate the clip-and-paste features in the system. The speed of the software may be disappointing at times, but look at the bright side: you'll be getting a head start toward using OS/2 Presentation Manager, which closely resembles* Windows.

VM/386 *is for the 386 user who has the time, knowledge, and desire to customize his or her virtual machines. The program won't entertain you with lots of windows, but the total independence of its virtual machines is to be applauded and should be emulated by the competition.*

The two multiuser/multitasking systems we evaluated, PC-MOS/386 *and* Concurrent DOS 386, *can't really compete as multitaskers against the specialized multitasking environments. Remember, however, that they do offer multiuser capabilities as part of their purchase price.*

VM/386 makes no pretension of windowing. When operating in the foreground, each virtual machine gets exclusive access to the display. Background applications are hidden but are assigned memory that mimics what the display actively uses, so they can be readily switched on-screen. During testing, no applications poked through to the foreground.

Each virtual machine operates truly independently and can even be booted with a press of Ctrl-Alt-Del without disturbing the rest. Each machine also accepts its own device drivers independently.

I/O ports must be assigned to each virtual machine through special drivers and control programs supplied with the *VM/386* package. You're allowed the option of assigning a port exclusively to a single virtual machine or sharing it among several.

VM/386 doesn't have explicit provisions for communicating between different virtual machines. Because all machines share the same file system, however, information can be passed around by writing data to a file in one virtual machine and reading it in another.

ON THE NETWORK IGC suggests that you take advantage of file sharing when using a *VM/386* system as a node in one of the LAN networks with which it is compatible (IBM Token-Ring, 3Com Token-Ring, NetWare/S-Net, and PCnet). Run the network device driver in one partition and use it to copy files to disk. All the virtual machines can then share the disk files. Use of a *VM/386* system as a server is not recommended.

Compared with windows-based multitasking systems like *Windows/386* and *DESQview*, *VM/386* is a step behind both in appearance and operation. Compared with the nonwindowing operating systems *Concurrent DOS 386* and *PC-MOS/386*, however, *VM/386* operates with commendable smoothness.

VM/386 is an environment that will best serve more experienced and dedicated users because they will have to experiment with its multitude of settings to coax optimal performance and memory usage from it. At the same time, having all those settings is *VM/386*'s greatest strength. It's the one multitasking system that you can tune to match your needs and desires. PC

Winn L. Rosch, who wrote all the reviews, is a contributing editor of PC Magazine.

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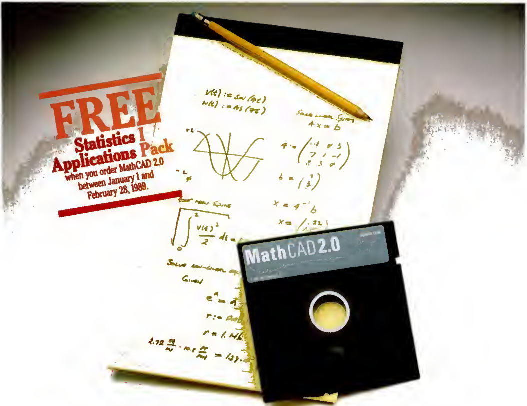

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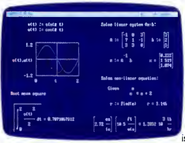

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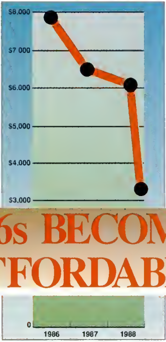
CIRCLE 154 ON READER SERVICE CARD

■ **COMPUTERS** ■ BRUCE BROWN AND STEPHANIE K. LOSEE

THE MIDRANGE HAS MOVED



386s BECOME AFFORDABLE

You knew it had to happen sooner or later: your last excuse for not buying a 386 computer—high price—has fallen away. For a while there, the alternatives to venturing into the land of 32-bit computing were pretty enticing. First the 386SX chip, in the guise of Compaq's Deskpro 386S, seemed a perfect 286 annihilator. Then 286 computers made a comeback with high-speed processors: first 16 MHz, then 20 MHz for those 386-leaners who might have turned to the 386 not for 32-bit functionality but for high processor speed.

Yes, if you avoided purchasing an 80386-based computer last year, you had a good defense. But with six respectable 16-MHz 386 performers—fully configured with 1MB of RAM, at least a 40MB hard disk, and VGA display—available now for under $3,500, choosing one of last year's alternatives may be this year's blunder.

With six fully configured 16-MHz 386s under $3,500 to choose from, the time has never been better to make the leap to 80386 computing.

The ongoing heated debate about the virtues of 386 computers can lead to only one conclusion: that we've come to a serious juncture in the PC marketplace, one demanding a rethinking of what denotes an entry-level machine and what makes for an office necessity. We should be used to such realignments by now; we've been forced into them every 2 years or so since IBM introduced the PC in 1981. And once again a period has hit wherein first-time buyers have a prime chance to miss the proverbial boat.

A discussion of the ramifications of the "cheap 386" begins not with 286-

level offerings but with XT clones. For those of us who wrote it off long ago, the XT is still breathing; in fact, in October 1988 a full 29 percent of our readers said they own 8088/8086-based computers. The XT's continued popularity should probably earn it the title "entry-level computer," but like its dead sibling, the original IBM PC, the time has come to bid it a fond farewell. The price differential between what XTs used to cost in their glory days and what off-brand ATs cost today is practically nil, and the present price gap of about $500 is not enough to warrant the purchase of a garage-sale computer. XT clones may still have a life as incidental at-home word processors, but they should no longer lay claim to office desktop real estate. Hobbling speed and 8-bit I/O and memory processing just can't mean entry-level in 1989.

> ■ If you're not afraid of mail order, you can have it all. Of course, "having it all" is never more than a temporary term.

That title has a new claimant: the 10-MHz or 12-MHz workhorse AT. All evidence to the contrary, the hoopla over the 386 doesn't invalidate the virtues of strait-laced 286s, which are undeniably capable of handling most major applications. It's when the megahertz ratings on ATs climb that the purchase becomes tougher to justify. Soaring into the 386 speed range is a pricey feat; fully configured, the six 20-MHz 286s we reviewed ("The 80286: Unsafe at Higher Speeds?" *PC Magazine*, December 31, 1988) ranged from $2,600 to $4,600. At the time, despite the obvious virtues of the six machines, we could not endorse one as Editor's Choice. Why spend that kind of money on a 286? Then and now, a better choice can be made than spending over $3,500 for a 20-MHz performer that lacks such generally recognized features of tomorrow's computing as 32-bit memory. That better choice is the bargain-basement 386: desktop computing's new midrange.

THE 386SX? The race to make the 80286 obsolete before its time is also being run by computers based on Intel's 386SX, but the contest is a little too early to call. When it was introduced, the 386SX, as the brains of Compaq's Deskpro 386S, moved pundits to declare that it would surely kill off 286 PCs before long. But as prices stand now, the Compaq 386S underprices neither fast 286s nor the low-end 386s reviewed in this issue. Yet again, it's the new crop of cheap 386s that provides the most computing for the least money. At the time of this writing Compaq's offering goes for $5,199 with 1MB of RAM and a 40MB hard disk. Clones, now dragging their feet, will undoubtedly adjust 386SX prices downward. But for now, if you're not afraid of mail order, you can have it all for far fewer dollars than ever before.

Of course, in the world of PCs, "having it all" is never more than a temporary term. No sooner did 25-MHz 386s emerge than we began to hear about upcoming 33-MHz models. And it's a sure bet that 12 days after you buy your very first 386 machine, Intel will announce the 80486 chip. A new high end will be established, and your lofty 386 will be reclassified as midrange. But you'll have covered yourself for the future: VM/386, new 386 applications, multitasking on a grand scale, and 32-bit environments—improvements that are already anticipated as well as possibilities that haven't yet been conceived.

And you'll be in increasingly populous company. As of October 1988, 17 percent of *PC Magazine*'s readers owned 386 computers, and Microsoft estimates that by the end of 1989, ATs and 386s will be purchased on a 1:1 ratio.

What about those stubborn 386 naysayers? Didn't they used to own XTs, which frustrated them to distraction and drove them to plunk down bigger bucks for a shiny new 286? Don't they realize that their yen for the 286 will at some point translate into an insatiable curiosity about *Microsoft Windows/386,* Unix, 32-bit extensions to DOS? Maybe the uncertainty of the market has finally gotten to them and they've chosen 286 as the computing level at which to end their quest for the ultimate upgrade. What they'll find out is that they quit one step prematurely.

Looming ahead, there must come a point of diminishing returns for business PCs, but 386 isn't it. Depending on what the 80486 chip brings to desktop computing, it may take a relatively long time to justify the jump from 386 to something higher; 386 may end up being a comfortable resting point for PC-buying companies. From there, new owners of 386s can watch the eventual decline of the 286 with satisfaction, knowing that they made the right choice; and they can listen patiently to the debate between Micro Channel and EISA. And if and when software catches up with hardware, they can enjoy the programs designed to take advantage of their 386s' various talents.

If the 16-MHz speed of these six low-cost 386s is a disappointment, hang on a while. A group of inexpensive 20-MHz 386s is nipping at the heels of this one; you can expect to see reviews of such speed demons in a few months, for perhaps less than $4,000. Like their 16-MHz predecessors, these machines will most likely come from mail-order vendors, but with companies like CompuAdd and Dataworld in the fray, it's tough to maintain the uptown bias.

The choice remains yours—get in on the action or stick with what you have now. Either way, you can't say we didn't warn you.—**Stephanie K. Losee**

Stephanie K. Losee is an assistant editor of PC Magazine.

ALTEC TECHNOLOGY CORP.

Altec ZIP 386/16

Most of us don't like to be told we have to compromise. In the case of Altec's ZIP 386/16, however, the trade-offs are obvious and fair. You give up a little performance and a brand name, and in return you get standard components and a nice price break.

The microprocessor in this machine is the ever-present Intel 80386-16. The motherboard is manufactured by Micronics Computers and can run the processor at 4.77, 6, 8, and 16 MHz with zero wait states, while maintaining a constant 8-

MHz bus speed for add-in-card compatibility. The ZIP uses the Phoenix Technologies ROM BIOS Plus, Version 1.10 03, dated January 1988. Standard BIOS-relocating software can be set to use the memory above 640K for both the video and the ROM BIOS. The ZIP 386/16 does not use interleaved memory or a memory cache.

One megabyte of static-column RAM chips comes standard on the memory card. The DIP-style chips hold 256 kilobits each and are rated at 80 nanoseconds. A maximum of 2MB of RAM can be installed on the card, which fits into the single 32-bit expansion slot, also made by Micronics. In addition to the 32-bit memory slot, there are four 16-bit and three 8-bit slots. On the test machine two 8-bit and three 16-bit slots were free.

The 285-watt power supply—the highest wattage tested in this group—has four device power leads and a switched outlet. The machine has five half-height drive bays, three of which have exposed fronts for removable media.

The keyboard, manufactured by Monterey Electronics, is of the enhanced AT style and is unexceptional other than for its shorter-than-normal 3-foot cable. The keyboard response and feel are adequate.

The Western Digital 1:1 interleave controller works wonders for the Seagate ST-251 drive. Lots of vendors use the formatted 43MB ST-251. Although the drive is officially rated at 40 milliseconds, a well-known trick is to divide it into two 20MB partitions, which usually results in better-than-30-ms. performance. With the 1:1 controller, however, Altec has gone one better and can attain seek-time averages in the low 25-ms. range. In addition to the hard drive, the ZIP has a TEAC 1.2MB, 5¼-inch floppy disk drive.

The tested unit came with a Video Seven 8-bit VEGA VGA video card and a Sony VGA monitor.

All service on Altec computers is done in the factory in California. The ZIP 386/16 comes with the fairly standard 1-year parts-and-labor warranty with shipping costs split between the user and the company. Altec also offers a 30-day money-back guarantee on its systems, with three conditions: monitors and printers are not returnable, the user must pay the round-trip shipping charges, and the user must allow 30 days to receive the refund check.

In sum, the Altec ZIP 386/16 is a reasonable deal. Altec itself is not terribly well known, but the component parts used are fairly standard. You give up just a bit of performance, but you save a few hundred dollars in the process. Sounds like a good compromise to me.

The Altec ZIP 386/16 offers you a swift 43MB hard disk, 1MB RAM, and VGA display for $3,235. This machine has the biggest power supply of the lot, delivering an impressive 285 watts. All that extra power may go wasted, however, since the computer has only four power-supply device connectors.

Photographs: Thom O'Connor

■ Altec itself is not well known, but the component parts it uses are fairly standard.

FACT FILE

Altec ZIP 386/16
Altec Technology Corp.
5751 Rickenbacker Rd.
Los Angeles, CA 90040
(800) 255-9971

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,845; with 43MB hard disk, monochrome monitor, DOS 3.3, $2,445; with VGA monitor, $3,235.

In Short: The Altec ZIP 386/16 offers standard components for a bargain-basement price. You'll give up a little performance, but on the disk side the ZIP's 1:1-interleave hard drive controller boosts its disk drive scores to better than average.

CIRCLE 692 ON READER SERVICE CARD

16-MHz 386-based Computers: Summary of Features

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Basic configuration Because hardware vendors frequently offer a choice among various hard disk drives and monitors—at different prices—we are reporting the price of a completely stripped-down model as a "basic" configuration.

Software included Hardware manufacturers may or may not bundle software with their computers. Bundled software may include DOS, setup and install programs, and various utilities. DOS is often available only at an additional cost.

Reset switch Many computers now come with a reset switch allowing a cold reboot of the computer. This switch saves wear and tear on the power switch.

Standard configuration Purchasers will normally want a more elaborate system than our "basic" configuration. For the sake of price comparisons, our "standard" configuration includes 1MB RAM, a hard disk of at least 30MB, one floppy disk drive, a monochrome display, at least one parallel and one serial port, DOS, and a keyboard. The price of each system is followed by the size of its hard disk.

Tested configuration The specifications (and list prices) of the evaluation units depend on what configuration each manufacturer has decided to send us for testing. **Upgrades and additions to the basic configuration** summarizes what distinguishes the models that were actually reviewed from the basic configuration.

Bus clock speeds (MHz) Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 or 10 MHz. Time-out periods, sometimes called **wait states,** are often used to slow down the bus.

Disk controller manufacturer and type Disk encoding techniques currently include RLL (Run Length Limited) and the older MFM (Modified Frequency Modulation) scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. Nine such bits would be needed to store 12 bits of data in MFM format, and only six polarity changes are required with RLL format; thus, MFM takes more space than RLL but provides a more stable environment and is more commonly used.

BIOS version and date The BIOS date is important to those planning to use 3½-inch disk drives. Early BIOS versions cannot handle this format.

Memory chip type Kb and Mb refer to kilobits and megabits, respectively.

Chip packaging Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs. The Dual In-line Package (DIP) is the traditional buglike computer chip sprouting 8, 14, 24, or even 40 or more metal legs (evenly divided between right and left sides). Single In-line Packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. Single In-line Memory Modules (SIMMs), on the other hand, are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement duplicates the integrated structure of a SIP but allows for the possibility of replacing an individual memory component if necessary.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the tradeoff is in slower processing and operation.

Static column RAM uses SRAM chips arranged electrically as pages (using column address) rather than as individual words or bytes (using row address). Paging is desirable because the 80386 contains a prefetch instruction that allows it to deal with a full page of RAM.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS or video BIOS directly into fast RAM on boot-up of the computer. The BIOS then operates much faster.

Disk cache software Some companies provide their own software to facilitate caching. Other computers can generally take advantage of the caching facility within some version of DOS.

Maximum 32-bit RAM There is currently no standard for 32-bit cards, and not many cards are available today. Many computer manufacturers, however, have designed their own 32-bit slots for memory expansion cards. 32-bit slots for memory cards are especially important in the era of OS/2, a memory-hungry operating system.

FCC certification class Two classes of FCC (Federal Communications Commission) approval may be given to computers: Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

BASIC CONFIGURATION	SAM 3081/386	Altec ZIP 386/18	PC Dataworld Data 386/16	Swan 386/16	CompuAdd 388/16	PC Zeos 386-18/FS
List price	$1,595	$1,845	$1,897	$1,969	$1,995	$2,185
RAM	1MB	1MB	1MB	1MB	1MB	1MB
Floppy disk drives	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch
Hard disk drive	None	None	None	None	None	None
Drive bays	Five half-height	Five half-height	Five half-height	Five half-height	Five half-height	Five half-height
Software included	None	Utilities	EMS memory drivers	Utilities	EMS memory drivers	Utilities
OS/2 available	○	○	○	○	○	○
Monitor	None	None	None	None	None	None
Ports	Two serial, two parallel	One serial, one parallel	One serial, one parallel	Two serial, one parallel, one game	None	Two serial, one parallel, one game
Slots	Two 8-bit, four 16-bit, two 32-bit	Three 8-bit, four 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Three 8-bit, four 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	Two 8-bit, six 16-bit
32-bit bus manufacturer	American Digicom	Micronics	Micronics	Twinhead International	Micronics	Mylex
Power supply (watts)	230	285	230	200	200	230
Reset switch	●	●	●	●	●	●
Keyboard cable length (inches)	60	36	72	72	60	72
STANDARD CONFIGURATION						
Price of monochrome system with 1MB RAM, hard disk, and DOS	$1,995 (43MB)	$2,445 (43MB)	$2,617 (43MB)	$2,588 (43MB)	$2,731 (44MB)	$2,832 (49MB)
Price of VGA system	$2,995 (43MB)	$3,235 (43MB)	$3,422 (43MB)	$3,087 (43MB)	$3,287 (44MB)	$3,527 (49MB)
TESTED CONFIGURATION						
List price	$2,995	$3,145	$3,479	$2,998	$3,208	$3,429
Upgrades and additions to the basic configuration	43MB hard disk, VGA monitor, DOS 3.3	43MB hard disk, VGA monitor	43MB hard disk, VGA monitor, DOS 3.3	43MB hard disk, VGA monitor	44MB hard disk, VGA monitor, I/O card	49MB hard disk, VGA monitor
Microprocessor clock speeds	6/8/16 MHz	4.77/6/8/16 MHz	4.77/6/8/18 MHz	8/16 MHz	4.77/6/8/16 MHz	6/16 MHz
Bus clock speeds	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz
Wait states	1	0	0	0, 1	0	0, 2, 3
Disk controller manufacturer and type	Western Digital (MFM)	Western Digital (MFM)	Date Technologies (RLL)	NCL (MFM)	NCL (MFM)	Adaptec (RLL)
System drive capacity	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives
BIOS version and date	Award BIOS, Version 3.03 (December 1987)	Phoenix BIOS Plus, Version 1.10 03 (January 1988)	Phoenix BIOS Plus, Version 1.10 B2 (January 1988)	Phoenix BIOS Plus, Version 1.10 01 (August 1988)	Award BIOS, Version 3.03, Rev. B (September 1987)	AMI BIOS (January 1988)
System board manufacturer	American Digicom	Micronics	Micronics	Twinhead International	Micronics	Mylex
386 chip set manufacturer	Intel	Intel	Intel	Intel	Intel	Intel
MEMORY SPECIFICATIONS						
Memory chip type	256Kb	256Kb	256Kb	256Kb, 1Mb	256Kb	256Kb
Chip packaging	DIP	DIP	DIP	SIMM	DIP	DIP
RAM chips	Static column	Static column	Static column	DRAM	Static column	DRAM
Interleaved memory	○	○	○	●	○	○
Shadow RAM	●	●	●	●	●	○
Type of cache controller	None	None	None	None	None	None
Disk cache software	○	○	○	○	○	○
Maximum RAM on motherboard	N/A	N/A	N/A	N/A	N/A	4MB
Maximum 32-bit RAM	4MB	2MB	10MB	16MB	4MB	8MB
Maximum total system RAM	16MB	16MB	18MB	16MB	16MB	16MB
OTHER						
Warranty	1 year (90 days on hard disk)	1 year	1 year	1 year	1 year	1 year
FCC certification class	B	B	A	A	B	A

PC—Editor's Choice ●—Yes ○—No N/A—Not applicable: RAM is located on memory cards rather than on the motherboard.

COMPUADD CORP.

CompuAdd 386/16

CompuAdd Corp. is one of the companies that legitimized mail-order computer purchases a few years ago. Along with others, most notably Dell Computer Corp., CompuAdd proved that computer sales and service can make sense by mail and telephone. CompuAdd's entry in this set of machines, the CompuAdd 386/16, is a good example of the kind of value you can get for dollars spent by mail.

The CompuAdd 386/16's Intel 80386-16 processor can be set via software to run at 4.77, 6, 8, or 16 MHz. The slower speeds ensure compatibility with the earlier IBM PC, XT, and AT machines.

For expansion-card compatibility, the system's expansion slots all run at 8 MHz. The Micronics-manufactured motherboard has eight expansion slots: two 8-bit, five 16-bit, and one 32-bit memory card slot. As configured for testing, both 8-bit slots and two 16-bit slots were free for add-ins.

CompuAdd computers used to come with the Phoenix Technologies ROM BIOS; in fact, the test unit had a Phoenix sticker on the back. The company is switching to Award Software's BIOS, however, which is what was actually installed in our machine. The version was 3.03, dated September 1987.

The CompuAdd's system memory runs

The Intel 80287 and 80387 Coprocessors vs. the Weitek 1167

Your choice of math coprocessor may influence your 386 buying decision. Not all computers support the faster but costlier Weitek 1167.

	Intel 80287	Intel 80387	Weitek 1167
Price	$410	$700	$1,200
Coprocessor speed	10 MHz	20 MHz	20 MHz
Type	I/O-mapped	I/O-mapped	Memory-mapped
Single precision	●	●	●
Double precision	●	●	●
Extended precision	●	●	○
Number of chips	1	1	3
Number of pins	40	68	121
Number of data lines	16	32	32

●—Yes ○—No

The Weitek 1187 is a **memory-mapped** device. Memory mapping permits the 1167 to use a block of addresses anywhere in a microprocessor's memory space. The microprocessor's full instruction set can be used for I/O operations.

By contrast, the Intel coprocessors are **I/O-mapped**. This means that an Intel coprocessor must use addresses in a separate 64K I/O address space. Special I/O instructions are available for communications with the coprocessor.

All three coprocessors follow Revision 754 of the IEEE standard for binary floating-point arithmetic. In addition, all three support **single-** and **double-precision** formats; the Intel coprocessors also support the **extended-precision** format. A single-precision number has 32 bits; double-precision, 64 bits; and extended-precision, 80 bits.

Data lines are the pins on the chip that are dedicated to sending and receiving data such as numbers and program instructions.

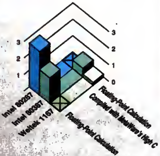
Benchmark Tests

These three coprocessors were tested with two Compaq computers. On the Compaq 386/16 (which supports the Intel 80287 and 80387), we ran PC Labs' standard Floating-Point Calculation benchmark test. On the Compaq 386/20 (which supports the Intel 80387 and Weitek 1167), we used the same test but compiled it with MetaWare's *High C* compiler. The Weitek 1167 got through the test three times as fast as the Intel 80387.

(We also ran the *High C*-compiled version of the test using the Compaq 386/16 and the Intel 80387. This took 0.71 seconds.)

Note that on the Compaq 386/16 the clock speed of the 80287 is jumper-selectable to 6 or 8 MHz. It was set to 8 MHz for testing.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.



Performance Times
(Times given in seconds)

	Floating-Point Calculation	Floating-Point Calculation Compiled with MetaWare's High C
Intel 80287	2.63	N/A
Intel 80387	1.54	0.52
Weitek 1167	N/A	0.17

N/A—Not applicable: the test machine does not support this coprocessor.

FACT FILE

CompuAdd 386/16
CompuAdd Corp.
12303 Technology Blvd.
Austin, TX 78727
(800) 666-1872
(512) 250-1489

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,995; with 44MB hard disk, monochrome monitor, DOS 3.3, $2,731; with VGA monitor, $3,287.

In Short: CompuAdd's 386/16 is yet another respectable performer from this large mail-order vendor. The high-speed 44MB drive and top-name components make for a good deal, backed by the company's established service reputation and 30-day money-back guarantee.

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CIRCLE 111 ON READER SERVICE CARD

THE ESDI HARD DISK ALTERNATIVE

Although 16-MHz 80386-equipped PCs are high-performance computers, the budget-priced machines reviewed here uniformly lack one productivity-enhancing feature used by more-expensive hardware: the ESDI hard disk and controller.

ESDI stands for Enhanced Small Device Interface, a set of standards that specify how a hard disk or similar device is connected to its control circuitry. ESDI is becoming a popular alternative to the ST-506 interface used by most hard disks on XT- and AT-compatible computers, including the 80386-based machines reviewed here.

In operation, the biggest difference you'll notice between the two interfaces is that ESDI races along twice as fast. While the ST-506 interface transfers information between the disk and the controller at a 5-MHz rate, ESDI moves bytes at 10 MHz. The higher speed permits ESDI drives to load, save, and copy files faster, an effect that is particularly noticeable when working with larger files.

To achieve its higher speed, ESDI packs twice as much data on each disk track. The disk itself spins at the same speed under the ESDI and ST-506 standards—3,600 rpm—but because of its denser information, ESDI moves data twice as fast.

The ESDI interface is used mostly by larger drives—those with capacities in excess of 100MB. The greater data density of ESDI itself helps drive makers achieve higher capacities. In addition, big drives benefit most from ESDI's higher speed and other features.

The higher transfer rates of ESDI drives also mate well with low average access times so that the benefits of fast data transfer will deteriorate less as files lose their contiguity with repeated updating. Consequently, the ESDI connection is almost uniformly limited to expensive, high-performance, high-capacity hard disks that cannot be included with these budget 80386-based computers. Many ESDI drives cost more than one of these complete systems; top-of-the-line models priced in excess of $5,000 are not uncommon.

When your budget allows, however, you can improve your inexpensive 386's capacity, performance, and responsiveness by upgrading its hard disk from the possibly mediocre model that the computer includes to an ESDI drive.

To make this upgrade, you'll need both a new hard disk and a new disk controller. Although ESDI uses the same physical cables as ST-506, the drives and controllers that follow the two standards are not interchangeable. An ESDI drive will not work with an ST-506 controller, and vice versa.

You'll have to be careful when checking the compatibility of your computer and any ESDI drive system you're thinking of buying. The BIOS code of some systems has built-in support for ESDI drives; other machines lack such provisions. You'll probably be best served by ESDI controllers that ignore the CMOS setup provisions of your computer and insert their own BIOS routines for handling your new ESDI drive.

—Winn L. Rosch

Winn L. Rosch is a contributing editor of PC Magazine.

with zero wait states. The standard memory complement is 1MB of 80-nanosecond static-column RAM, with room for an extra 1MB on the memory card. A 2MB piggyback card is available from CompuAdd for a maximum of 4MB of 32-bit RAM. In all, the system will support 16MB of RAM. The CompuAdd 386/16 doesn't use interleaved memory (unnecessary because of the machine's zero-wait-state operation), nor does it have a memory cache. Software for relocating both the ROM BIOS and video BIOS for shadow RAM and video is included.

The system unit features a 200-watt power supply with four device connectors and a switched outlet. The Hi-Tek keyboard from MNB Technologies has a 5-foot cable and is reasonably responsive. There is room for five half-height storage devices in the system unit, three with exposed fronts.

CompuAdd, the king of respectable mail-order computers, sells its CompuAdd 386/16 with 1MB RAM, a 44MB hard disk, and VGA video for $3,287. The box is filled with high-quality components, including a speedy hard disk.

Mother Nature Can Teach Us A Lot About Hard Disks.

It can happen with no warning. The sky goes dark and then it's there. A whirling funnel that destroys everything in its path, leaving little or nothing that can be retrieved. Just the way that disaster can strike your hard disk, scattering your data to the wind.

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CIRCLE 286 ON READER SERVICE CARD

16-MHz 386-based Computers

PC Labs tested six 16-MHz 386 computers and then normalized the results against timings for the Compaq Deskpro 386/16 as well as the standard 8-MHz IBM PC AT.

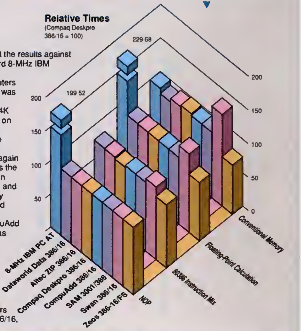
The NOP test showed negligible differences among the computers tested. This result is not surprising, as Intel's 80386-16 processor was used by all systems. On the 80386 Instruction Mix test, the Zeos 386-16/FS commandeered a healthy lead. The Zeos employs a 64K memory cache of 32-bit static column RAM chips inserted directly on the system board. Following the Compaq, the Altec ZIP 386/16, CompuAdd 386/16, and SAM 3001/386 shared third place. These three machines provide zero-wait-state operation.

Zeos easily took first place on the Conventional Memory test, again because of its 64K memory cache and fast SRAM chips. Next was the Dataworld Data 386/16 with its 32-bit 80-nanosecond static column RAM, followed by the trio of Altec ZIP 386/16, CompuAdd 386/16, and SAM 3001/386. All three use static column RAM on 32-bit memory cards, the Altec with 80-nanosecond chips and the CompuAdd and SAM with 100-nanosecond chips.

Winning the small-record DOS File Access test was the CompuAdd 386/16, using MFM encoding with a MiniScribe hard disk. Next was the SAM 3001/386 with a Seagate hard disk partitioned into two virtual drives, followed by the Swan 386/16, which uses a Seagate disk with an MFM controller.

On the large-record DOS File Access test, the leaders were Dataworld, Zeos, and Altec. The Dataworld Data 386/16 and the Zeos 386-16/FS use RLL technology with a 1:1 interleave factor on a Seagate disk, while the Altec ZIP 386/16 uses MFM encoding with a Seagate disk. The three winners on the BIOS Disk Seek were the Altec ZIP 386/16, CompuAdd 386/16, and SAM 3001/386.

PROCESSOR AND MEMORY BENCHMARK TESTS



Performance Times (Times given in seconds except where noted)	PROCESSOR AND MEMORY BENCHMARK TESTS				DISK BENCHMARK TESTS		
	NOP	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milliseconds)
8-MHz IBM PC AT	4.17	N/A	35.60	0.77	72.63	19.74	29.20
Dataworld Data 386/16	2.10	4.14	15.51	0.71	68.71	6.61	38.38
Altec ZIP 386/16	2.09	4.12	15.47	0.75	61.75	8.79	25.14
Compaq Deskpro 386/16	2.09	4.01	15.50	0.77	61.74	13.42	18.10
CompuAdd 386/16	2.09	4.12	15.47	0.75	49.25	17.85	29.16
SAM 3001/386	2.09	4.12	15.50	0.75	53.59	17.73	29.48
Swan 386/16	2.09	4.34	18.24	1.05	59.56	18.63	38.39
Zeos 386-16/FS	2.09	3.77	13.58	0.57	69.41	6.79	38.96

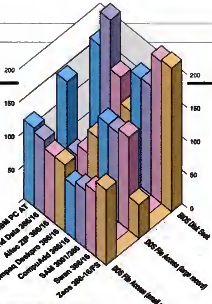
N/A–Not applicable the IBM PC AT is an 80286-based computer

The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.



▲
DISK BENCHMARK TESTS

Relative Times
(Compaq Deskpro 386/16 = 100)

The **DOS File Access** benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks–file creation, sequential file write, sequential file read, random file write, and random file read–are timed and the results summed.

The test is carried out for two different types of files–small-record files and large-record files–that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

PC Labs Benchmark Series: What's New in Version 4.2

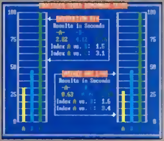
Version 4.2 of PC Labs Benchmark Series is easy to install, displays graphs, and supports DOS 4.0.

Benchmark-test programs exist in a constant state of flux. Changes to the PC Labs Benchmark Series are generated in response to requests from users and vendors as well as advances in the technologies involved. Our latest release, Version 4.2, includes a simplified installation procedure, improvements in the display of processor speed results, and some incremental fine-tuning.

Because of the space the programs required in the previous version, they had to be compressed before being copied to the distribution diskette and un-arced during installation. Many users claimed that this procedure was excessively complicated. As a result, we have used the EXEPACK program to shrink the files, allowing the Version 4.2 disk to be distributed with the programs in executable form. Un-arcing is no longer required.

Some changes were made in order to keep up with enhancements to DOS. For example, the DOS Disk Access test is now compatible with IBM DOS 4.0 and Compaq DOS 3.31 extended partitions (those partitions that allow more than 32MB of disk storage).

The processor speed tests received the most revamping. Previous versions displayed numeric results consisting of the timing for each test and an "Index" relative to two standard machines previously tested at PC Labs, the 8-MHz IBM AT and the 4.77-MHz IBM PC. With Version 4.2, the results are presented both numerically and graphically; a bar chart contrasts the performance of the machine being tested with the scores of the other two machines. The run times for each test are normalized against the slowest of the three machines being compared. A shorter bar indicates faster execution of a test.



```
Results in Seconds
  A        B
 2.02     4.12
Index A vs. B:  1.5
Index A vs. C:  3.1

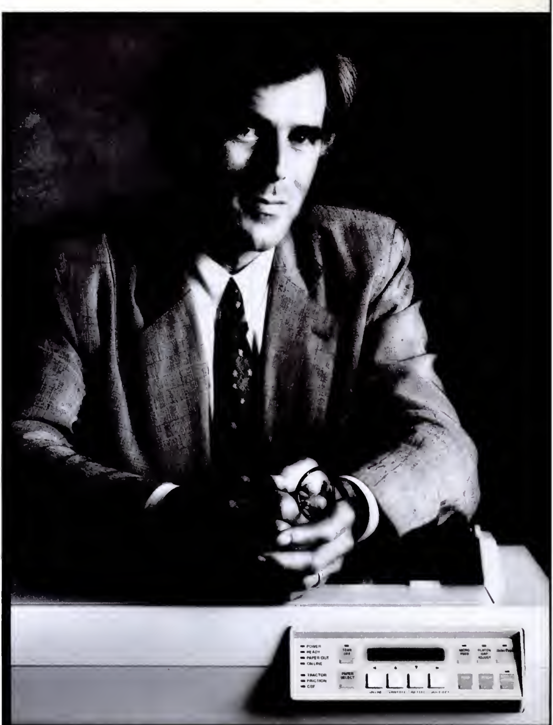
Results in Seconds
  A
 0.63
Index A vs. B:  1.6
Index A vs. C:  3.4
```

The processor type and clock speed of the machine being tested are now displayed in the lower-left corner of the screen. This feature will allow you to confirm that your machine is running at its rated speed. The speed value will accurately follow shifts in and out of turbo mode on machines equipped with this mode.

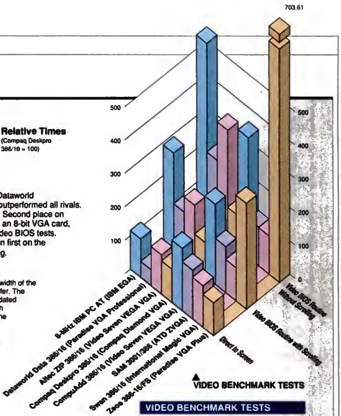
The computers used for comparison are chosen automatically, based on the processor type of the machine being tested. If the processor is an Intel 80386, the 8-MHz IBM AT and the 16-MHz Compaq 386 will be used for comparison. Otherwise the 8-MHz IBM AT and the 4.77-MHz IBM PC will be used.

You can enter commands to select a test to run, view a summary screen containing all results, cycle through all tests continuously, or cycle through the tests stopping on the summary screen. All commands are explained in the introductory screens at the beginning of the test session.

You'll see additional improvements in PC Labs Benchmark Tests as advances in computer technology suggest them.–**Stuart R. Greenberg**


POWER
READY
PAPER OUT
ON LINE
TEAR OFF
MICRO FEED
PLATEN GAP ADJUST
TRACTOR
FRICTION
CSF
PAPER SELECT

16-MHz 386-based Computers



Relative Times
(Compaq Deskpro 386/16 = 100)

Speediest on the Direct to Screen test was the Dataworld Data 386/16; with a 16-bit VGA card, it handily outperformed all rivals. However, it came in third on both other video tests. Second place on Direct to Screen went to the Zeos 386-16/FS using an 8-bit VGA card, but its performance dropped to last place on the Video BIOS tests. The Swan 386/16, using an 8-bit VGA card, came in first on the Video BIOS Routines both with and without scrolling.

The **Direct to Screen** benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.

The **Video BIOS Routine with Scrolling** benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

The **Video BIOS Routine Without Scrolling** benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.

VIDEO BENCHMARK TESTS

Performance Times
(Times given in seconds)

	Direct to Screen	Video BIOS Routine with Scrolling	Video BIOS Routine Without Scrolling
8-MHz IBM PC AT (IBM EGA)	4.90	7.60	4.50
Dataworld Data 386/16 (Paradise VGA Professional)	2.05	3.66	1.79
Altec ZIP 386/16 (Video Seven VEGA VGA)	5.00	4.85	2.75
Compaq Deskpro 386/16 (Compaq Diamond VGA)	4.23	2.60	0.83
CompuAdd 386/16 (Video Seven VEGA VGA)	7.92	6.22	2.97
SAM 3001/386 (ATD ZVGA)	6.22	3.57	0.96
Swan 386/16 (International Magic VGA)	5.31	2.58	0.95
Zeos 386-16/FS (Paradise VGA Plus)	4.20	8.24	5.84

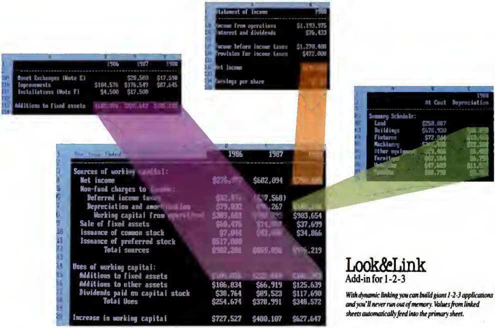
The CompuAdd 386/16 comes with either a Western Digital or an NCL America floppy/hard disk controller. Both are standard MFM controllers, and each can handle two floppy disk drives and two hard disks. The test unit had the NCL controller as well as a 1.2MB Newtronics floppy drive and a 44MB 25-millisecond MiniScribe hard drive, which performed well but was not as fast as some slower-rated drives with fancier controllers.

Like the Altec ZIP 386/16, the CompuAdd 386/16 VGA test system boasted a Video Seven 8-bit VEGA VGA monitor card, but the CompuAdd had a Mitsubishi VGA monitor.

The CompuAdd 386/16 didn't score particularly high on the benchmark tests, usually in the middle of the field. Its list price of $3,208 in the tested configuration also falls in the middle of a range that extends from $2,995 to $3,479.

CompuAdd has a standard 1-year parts-and-labor warranty. The company also subscribes to the standard practice of paying for one-way shipping to replace defective parts or whole computers, employing the same shipping method used by the customer. And CompuAdd furnishes the ubiquitous 30-day money-back guarantee.

If the idea of buying a computer through the mail makes you nervous, CompuAdd just may be the company to change your mind. True, it's a mail-order house, but at least it's a *big* mail-order house with a reputation for well-built machines and quality service at excellent prices. You won't go wrong with the CompuAdd 386/16.



```
                                    1986      1987      1988
Asset Exchanges (Note E)                    $20.500   $17.590
Improvements                    $104.576  $176.549   $87.645
Installations (Note F)            $4.500   $17.500

Additions to fixed assets       [illegible]
```

```
tatement of income                          1988
income from operations                $1,193,975
nterest and dividends                    $76,433

ncome before income taxes             $1,270.408
rovision for income taxes               $472.008

et income
arnings per share
```

```
                                              1988
                               At Cost  Depreciation
Summary Schedule:
  Land                        $250.007
  Buildings                   $678.930
  Fixtures                     $72.844
  Machinery
  Other equip
  Furnit
```

```
For Year Ended                      1986       1987       1988
Sources of working capital:
  Net income                   [illegible]   $602,094
  Non-fund charges to income:
    Deferred income taxes      [illegible]  ([illegible]7,560)
    Depreciation and amortization [illegible]  [illegible],267
      Working capital from operations [illegible] [illegible]  $983,654
  Sale of fixed assets           $60,476    $74,[illegible]   $37,699
  Issuance of common stock        $7,014   [illegible]        $34,866
  Issuance of preferred stock   $517,000
        Total sources          [illegible]  [illegible]   [illegible],219

Uses of working capital:
  Additions to fixed assets    [illegible]
  Additions to other assets     $186,834    $66,919    $125,639
  Dividends paid on capital stock $30,764   $89,523    $117,690
        Total Uses              $254,674   $370,991    $348,572

Increase in working capital     $727,527   $400,107    $627,647
```

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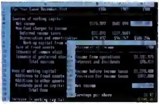

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PC2/89

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DATAWORLD INC.

Dataworld Data 386/16

Here's a switch. When competing against pricey, big-name computers, Dataworld's entry is often the least-expensive speed demon of the bunch. This time around, the Dataworld Data 386/16 is at the top of the price scale, but its performance rides right along with its price.

The Dataworld Data 386/16 starts with the common Micronics motherboard, incorporating an Intel 80386-16 processor and 1MB of 80-nanosecond static column RAM on a 32-bit memory card. The card can hold up to 2MB of RAM and can accept piggyback cards in various configurations, the largest holding 8MB, for a system total of 10MB of 32-bit RAM. An additional 6MB of RAM can be installed on memory cards in one of the 16-bit expansion slots, to bring the Data 386/16 to its maximum of 16MB.

The processor can be set by software to run at 4.77, 6, 8, or 16 MHz, with the expansion slots fixed at 8 MHz. The system works with zero wait states, eliminating the need for memory interleaving. There is no cache memory, but BIOS relocation software is included. The standard BIOS is Phoenix's 80386 ROM BIOS Plus, Version 1.10 B2, though the company will supply an Award BIOS on request.

EDITOR'S CHOICE

FACT FILE

Dataworld Data 386/16
Dataworld Inc.
3733 San Gabriel River Pkwy.
Pico Rivera, CA 90660
(800) 722-7702

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,897; with 43MB hard disk, monochrome monitor, DOS 3.3, $2,617; with VGA monitor, $3,422.

In Short: Dataworld offers the most expensive computer in this group by a nose (based on tested configurations), but the top-flight components, including a Paradise Professional 16-bit VGA card and a NEC MultiSync II monitor, justify the price. The super NCL drive controller enabled the Data 386/16's otherwise pedestrian Seagate ST-251 hard drive to achieve top performance scores. All this and a 30-day money-back guarantee from a vendor with an increasing reputation for quality. How can you lose?

CIRCLE **690** ON READER SERVICE CARD

Dataworld didn't skimp on components when it put together its Dataworld Data 386/16, paying particularly close attention to video by adding a NEC MultiSync II monitor and a Paradise VGA card. Even the keyboard includes a convenient combination dustcover and paper holder. The whole package, with 1MB RAM and a 43MB hard disk, sells for $3,422.

The 230-watt power supply has four device leads, and the system box can hold five half-height storage devices, with up to three open to the front. There are a total of eight expansion slots: in addition to the 32-bit memory card slot, there are five 16-bit slots and two 8-bit slots. The tested system had one 8-bit and three 16-bit slots empty. The Dataworld keyboard is available separately, besides being supplied with each of the company's computers. It's an admirable unit with nice responsiveness and a combination dustcover/paper holder built right onto the keyboard.

While the Data 386/16 uses reasonably standard drives, a TEAC 1.2MB floppy disk drive and a Seagate ST-251R, the Data Technology 1:1-interleave RLL controller makes the hard drive sing. Overall, this drive combination put the Dataworld's drive times in the top tier on the disk benchmark tests.

The Data 386/16 is the only machine in this batch to come with a 16-bit video card, in this case the top-rated Paradise VGA Professional Card. To cap off the video side, the monitor supplied in the test configuration was the NEC MultiSync II. Now you can see why it isn't the least-expensive "cheap 386" machine, with two of the classiest video components on the market.

Dataworld makes all repairs at its plant in California. The Data 386/16 has a 1-year parts-and-labor warranty with the normal arrangement for shipping: the user and the vendor pay for shipping to each other, and the vendor sends it back by the same shipping method that the user employed. Dataworld also has a 30-day money-back guarantee.

There's no substantive reason to hold back from choosing the Data 386/16. While its raw processing speed may not match that of Zeos's machine with its 64K cache memory, the Data 386/16 has the best video setup in this group of computers, and it also has the best all-around hard disk performance. Add a crowd-pleasing keyboard and a company that is trying hard to satisfy a growing user base, and you have a winning combination.

HITECH INTERNATIONAL INC.

SAM 3001/386

If you're looking for the least-expensive fully configured 16-MHz 80386 computer in existence, look no further. HiTech International's SAM 3001/386 is the rock-bottom cheapest among the configurations tested, even if it beats out its nearest competitor by only $3. The SAM unit's benchmark-test performance scores hovered in the middle of the group, so there's certainly nothing to apologize for in that regard. The only slightly sour note is a less gracious warranty-and-service shipping policy than most of its competitors offer.

The SAM 3001/386 uses an American Digicom motherboard, which closely resembles the Micronics unit employed by several of the other vendors. HiTech International asserts that Micronics memory cards work well in this unit. The BIOS is the Award 386 Modular BIOS, Version 3.03, dated December 1987. The Intel 80386-16 processor operates at one wait state with selectable clock speeds of 6, 8, and 16 MHz. The expansion slots run along at 8 MHz.

HiTech International makes the cheapest 386 around; its SAM 3001/386 costs just $2,995 with 1MB RAM, a 43MB hard disk, and VGA display. The front panel adds interest with its "membrane" reset switch and nonfunctional turbo indicator.

One megabyte of 100-nanosecond static column RAM is standard on a memory card that can hold up to 2MB. An optional piggyback card will take an extra 2MB, for a total of 4MB of 32-bit memory and a system maximum of 16MB.

The system unit has the standard five drive bays for half-height floppy, hard, or tape drives. If all the bays were full, you would need to come up with an extra power lead from the 230-watt power supply, since it has the typical complement of four leads. The Western Digital floppy/hard disk controller is a vanilla, no-tricks unit that drives a TEAC 1.2MB floppy disk drive and a Seagate ST-251 43MB 40-millisecond hard drive. The hard drive is partitioned as two virtual 21MB drives, a common technique that achieves near-28-millisecond performance.

The Key Tronic keyboard has a 5-foot

FACT FILE

SAM 3001/386
HiTech International Inc.
1435 McCandless Dr.
Milpitas, CA 95035
(408) 263-3300

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,595; with 43MB hard disk, monochrome monitor, DOS 3.3, $1,995; with VGA monitor, $2,995.

In Short: As tested, HiTech's SAM 3001/386 is the least-expensive 16-MHz 386 computer now sold. With a full complement of features, the SAM 3001/386 performance test results come in at the middle of the pack. The only drawbacks to this machine are the lightweight warranty and the service shipping policies, although there is a reassuring 30-day money-back guarantee.

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cable that plugs into the rear of the unit. Key Tronic continues to be a big name in aftermarket and clone keyboards, but frankly I can't see why—their keyboards feel frustratingly mushy and unresponsive.

The test unit had an ATD 8-bit ZVGA card and a TW Casper monitor. This video combination proved faster than the 16-bit combination on the Dataworld Data 386/16 on the video benchmark tests.

An unusual but positive feature is the inclusion of two serial ports and two parallel ports as standard equipment on the SAM 3001/386.

HiTech offers the usual 1-year parts-and-labor warranty, but that doesn't cover hard drives, which are limited to 90 days. Another limitation concerns HiTech's warranty/service shipping policy. Most mail-order competitors require that customers pay to ship defective units back to the factory, and the vendor reciprocates by matching the method of shipment used by the customer. HiTech makes customers pay for shipping both ways. That's no way to reassure potential customers that buying mail-order is a good idea. To its credit, however, HiTech has a 30-day money-back policy.

■ Price isn't the only factor when choosing a computer, but the SAM 3001/386's low price does buy a competently performing machine with fairly standard parts.

Price isn't the only factor to look at when choosing a computer, but in this case, the SAM 3001/386's low price buys a competently performing machine with fairly standard components. The warranty and shipping policies may be reason enough to look elsewhere, however, particularly for users who are leery of mail order.

TUSSEY COMPUTER PRODUCTS INC.

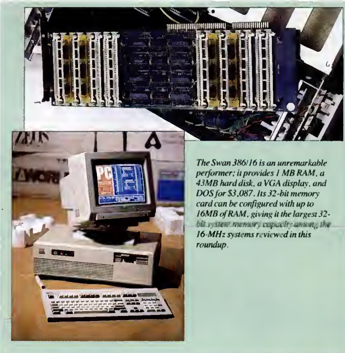
Swan 386/16

Bottom-line watchers, look up. Tussey Computer Products, a Pennsylvania mail-order house, sells one of the least-expensive 16-MHz 80386s around. At $2,998 with VGA and a 43MB drive, the Swan 386/16 costs only $3 more than the cheapest machine in this series. One trade-off is that the Swan offering is the slowest performer on the memory and processor benchmark tests. There's a bonus waiting for you on the Swan's motherboard, but some people advise against using it.

The Swan has a Twinhead International Corp. motherboard with the Chips and Technologies CS8230 CHIPSet and Phoenix 80386 ROM BIOS Plus, Version 1.10 01, ROM chips. The Intel 80386-16 processor can be set by software to work at either 8 or 16 MHz, and the expansion bus hums at the industry-standard 8 MHz for expansion card compatibility. In addition to a 32-bit memory card slot, there are three 8-bit and four 16-bit slots. Two of the 8-bit and two of the 16-bit slots were free in the test configuration.

A small jumper on the motherboard lets you push the machine to work at 20 MHz. Intel publicly advises against pushing its chips faster than the stated design specs, but common wisdom has it that processor chips can be pushed 20 to 25 percent above rating. Tussey Computer Products itself suggests that the computer might be unreliable when run at 20 MHz, but the test machine arrived with the jumper set to 20. The jumper is hard to get to, tucked under the leftmost hard-drive-bay framework, but with small fingers working from both sides you can change the setting without having to remove the whole motherboard from the box.

Our test results, which are unspectacu-



The Swan 386/16 is an unremarkable performer; it provides 1 MB RAM, a 43MB hard disk, a VGA display, and DOS for $3,087. Its 32-bit memory card can be configured with up to 16MB of RAM, giving it the largest 32-bit system memory capacity among the 16-MHz systems reviewed in this roundup.

PC MAGAZINE

"The Dataworld 286 [12 MHz] AT compatible...[is]... the fastest machine of the nine tested in that review [July 1988]." (September 27, 1988).

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PC MAGAZINE **EDITOR'S CHOICE**

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(October 11, 1988)

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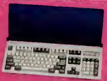

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3733 San Gabriel River Parkway, Pico Rivera, CA 90660-1495 lar, were all run with the Swan 386/16 set to 16 MHz. If you buy this machine, however, set it at 20 MHz and try it out for a while. If it works for a week or so with no errors, enjoy the extra speed and do regular backups for insurance.

The Swan's memory card is different from the others tested. The card takes either 256-kilobit or 1-megabit SIMMs in various combinations. Depending on the configuration, the card can hold from 1 to 16MB of memory, saving the cost of extra memory cards. The only drawback is that the Swan uses DRAM chips rather than the faster static-column RAM chips, so this slows it down a bit. The computer can be set to work with either zero or one wait state. There's also a program to enable shadow RAM and video as well as page-mode or two-way interleaving settings to speed up the computer.

The system unit has a 200-watt power supply with five power leads (one more than usual) and a switched outlet. There are five drive bays; three devices can have exposed fronts. The standard MFM-type NCL America–brand floppy/hard disk controller runs a Fujitsu 1.2MB floppy disk drive and a Seagate ST-251 43MB 50-millisecond hard drive. Also standard are two serial ports, one parallel port, and a game port. A passable Key Tronic Enhanced-style keyboard plugs into the rear

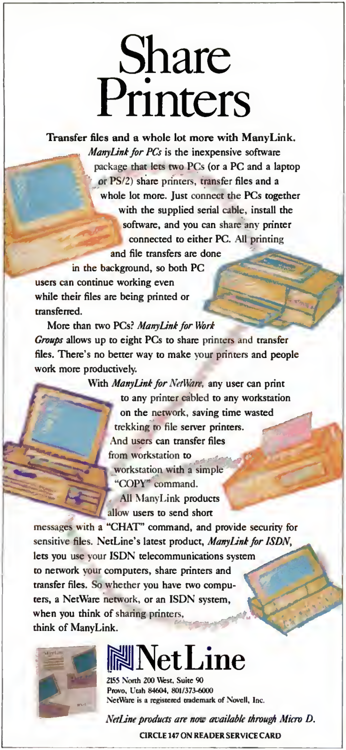
PC MAGAZINE FACT FILE

Swan 386/16
Tussey Computer Products Inc.
P.O. Box 1006
State College, PA 16804
(800) 468-9044

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $1,969; with 43MB hard disk, monochrome monitor, DOS 3.3, $2,588; with VGA monitor, $3,087.

In Short: The Swan 386/16 is a price leader, costing a mere $3 more than the cheapest machine in this series (based on tested-configuration prices). The Swan's processor and memory performance figures are lackluster, owing to the use of conventional DRAM memory chips and the lack of cache memory. There is an on-board jumper to enable 20-MHz operation, but Tussey itself recommends against using it

CIRCLE 688 ON READER SERVICE CARD



IBM
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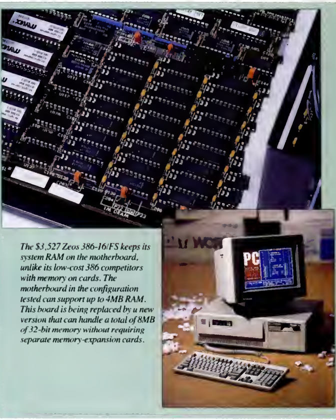
of the machine and has a 6-foot cable.

The test machine also came with a Twinhead International Magic VGA 8-bit video card and a Magnavox Professional monitor, a combination that yielded our best times on two of the video benchmark tests.

The Swan 386/16 was the slowest machine of the lot on most of the processor and disk tests. Operating the machine at its tweaked rating will certainly remedy its unspectacular benchmark-test times, although it may be riskier. None of the other speed-ups (such as BIOS relocation) were active in the tested configuration.

Tussey's warranty currently follows the standard formula, with parts-and-labor coverage for 1 year; the vendor pays for shipping on parts sent back to the customer after repair. There's also the obligatory 30-day money-back guarantee that many mail-order houses are offering. And you have the option of buying extended warranties to cover the hardware for up to 4 years after the computer purchase date.

If bottom-line cost is by far your most compelling purchase factor, and if the Swan 16's less-than-screaming speeds in default configuration are acceptable, this computer bears some attention. Otherwise, a few hundred dollars more spent on other machines in this series can buy faster memory and drive performance.



The $3,527 Zeos 386-16/FS keeps its system RAM on the motherboard, unlike its low-cost 386 competitors with memory on cards. The motherboard in the configuration tested can support up to 4MB RAM. This board is being replaced by a new version that can handle a total of 8MB of 32-bit memory without requiring separate memory-expansion cards.

ZEOS INTERNATIONAL LTD.

Zeos 386-16/FS

It's not the size of the wand that's important, but the magic of the magician. The number 64K isn't impressive these days, but when it refers to a memory cache of static column RAM, heads should pop up. The Zeos 386-16/FS blows away every other computer in this roundup. While the Zeos boasts other fine components as well, its memory cache has the biggest impact.

The motherboard, manufactured by Mylex, uses an Intel 80386-16 and can be set to either 6 or 16 MHz, with the expansion slots working at a straight 8 MHz. There is no 32-bit expansion slot; instead there are two 8-bit slots and six 16-bit slots on the board. One 8-bit and four 16-bit slots were free in the test machine. The AMI 386 BIOS is dated January 1988.

This is the only machine tested with RAM actually on the motherboard, not on a 32-bit memory card. The standard 1MB of DRAM chips, in this case rated at only 120 nanoseconds, can be increased to 4MB on the motherboard without purchasing an additional card. A new version of the motherboard, identical to the present issue but with the capacity of 8MB of 32-bit RAM chips, is currently available by request and will replace the older board as standard issue when the old boards are gone. Any additional memory will have to be on 16-bit memory-expansion cards. The memory works with 0, 2, or 3 wait states, depending on whether the computer finds what it needs in cache memory.

Cache memory works by holding recently accessed information in 4K "pages." If the computer can find what it's looking for next in the cache memory, performance is greatly enhanced. Compaq first used cache memory on a 386, and other speed-minded vendors have found that the trick pays off handsomely. According to Mylex, the information your computer needs next during normal application-program execution should be in the cache memory 81 percent of the time.

The Zeos system unit can hold five half-height drives, three open at the front, and four can be powered with device connectors from the 230-watt power supply. The keyboard, manufactured by Nan Tan Computer Co., is acceptable but not exceptional. Also standard are one parallel port, two serial ports, and a game port.

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CIRCLE 478 ON READER SERVICE CARD

EDITOR'S CHOICE

- **Dataworld Data 386/16**
- **Zeos 386-16/FS**

At first glance it may seem that these six low-end 386 computers come straight from Clone City. How else can a company cram 386 performance, 1MB of RAM, a 40MB hard disk, and a VGA card and monitor into a system priced at less than $3,500? Dataworld and Zeos have the answer. Unremarkable as they may appear, these two machines add performance features that belie their mail-order roots.

Both top-performing machines, the $3,479 Dataworld Data 386/16 and the $3,429 Zeos 386-16/FS, are also the most expensive by a tiny margin. The Dataworld offers a 16-bit video system with a top-quality NEC MultiSync II monitor and an exceptionally fast disk-drive controller for an impressive combination of value and performance. The Zeos's 64K cache memory gives it a clear edge on processor-based tests, even with the slowest memory chips in the bunch. Both Dataworld and Zeos follow CompuAdd's lead by building competent machines that are so aggressively priced and well supported that they effectively remove the angst from mail-order purchasing.

The test machine had an Adaptec RLL floppy/hard disk controller with a TEAC 1.2MB floppy disk drive and a Seagate 49MB 28-millisecond ST-157R hard drive. This controller-and-hard-drive combination worked very well, ranking second among the machines tested here in the number of top scores in the hard-drive-access benchmark tests.

EDITOR'S CHOICE

FACT FILE

Zeos 386-16/FS
Zeos International Ltd.
530 5th Ave. NW, #1000
St. Paul, MN 55112
(800) 423-5891

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, $2,185; with 49MB hard disk, monochrome monitor, DOS 3.3, $2,832; with VGA monitor, $3,527.

In Short: Even though the Zeos 386-16/FS uses relatively slow 120-nanosecond DRAM memory chips, the 64K cache memory takes the computer right to the top on processor and memory performance tests. The Adaptec RLL controller also enables the 49MB drive to achieve top scores. A growing company reputation and prominence, as well as a full selection of system options, make the Zeos a smart choice.

CIRCLE 687 ON READER SERVICE CARD

The 8-bit Paradise VGA Plus video card and Tatung VGA monitor in the test configuration performed well in actual use but attained relatively slow speeds on the video benchmark tests.

Zeos has a standard 1-year parts-and-labor warranty with split shipping costs. If a defective part is identified over the phone, the company will ship a new one at the same time you send in the bad one. Zeos also provides a toll-free technical-support line and a 30-day money-back guarantee.

Zeos is a rapidly growing mail-order house with a full line of computers and peripherals. You can order a computer from its parts lists, specifying everything from the amount of memory and the drive size to the size of the case. While the $3,429 Zeos 386-16 machine tested here is the second most expensive in the series, it also gets top scores for performance. If processor speed is your highest priority but budget ranks a close second, the Zeos 386-16 may be your computer.—**Bruce Brown**

Bruce Brown, who wrote all the reviews, is a computer consultant and a frequent contributor to PC Magazine.

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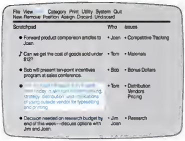
Dump any random, unrelated thoughts or ideas into Agenda, and it'll help you turn that information into a stream of structured, actionable knowledge.

We call it Lotus® Agenda®, the personal information manager.

Agenda allows you to dump random facts, thoughts, and ideas into your PC without having to structure the information in advance.

You can record the thousands of tasks you need to address to put together a new product line. Or the thousands of factors you need to put together a new bottom line.


File View Category Print Utility System Quit
New Remove Position Assign Discard Undiscard

Scratchpad	Who	Issues
• Forward product comparison articles to Joan.	• Joan	• Competitive Tracking
♪ Can we get the cost of goods sold under $12?	• Tom	• Materials
• Bob will present ten-point incentives program at sales conference.	• Bob	• Bonus Dollars
• [illegible] nday [illegible] ng, strategy distribution and [illegible]ications of using outside vendor for typesetting and printing	• Tom	• Distribution Vendors Pricing
• Decision needed on research budget by end of this week—discuss options with Jim and Joan.	• Jim Joan	• Research

***Items.** Dump information in manually, import it or use our pop-up capability while in another program.*

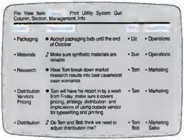
Agenda will not only file these random items of information for you, it'll help you arrange them any way you want.

So you can understand them better, formulate new ideas better and extract all the answers you need better.

Which means, now you can concentrate

Agenda's filing system is a more sophisticated version of this filing system. You can put items anywhere you want. View them any way you want. And have access to them anytime you want.

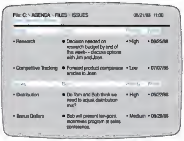
eryone who's any work done.



File View Item Print Utility System Quit
Column, Section, Management, Info

• Packaging	● Accept packaging bids until the end of October	• Liz	• Operations
• Materials	♪ Make sure synthetic materials are reliable	• Sue	• Operations
• Research	● Have Tom break down market research results into best case/worst case scenarios	• Tom	• Marketing
• Distribution Vendors Pricing	● Tom will have his report in by a week from Friday: make sure it covers pricing, strategy, distribution and implications of using outside vendor for typesetting and printing	• Tom	• Marketing
• Distribution	♪ Do Tom and Bob think we need to adjust distribution mix?	• Tom Bob	• Marketing Sales

Categories. Agenda files items in all relevant categories so you can always find the information you need.



File: C:\AGENDA\FILES\ISSUES 06/21/88 11:00

• Research	● Decision needed on research budget by end of this week-- discuss options with Jim and Joan.	• High	• 06/25/88
• Competitive Tracking	● Forward product comparison articles to Joan	• Low	• 07/07/88
• Distribution	● Do Tom and Bob think we need to adjust distribution mix?	• High	• 06/22/88
• Bonus Dollars	● Bob will present ten-point incentives program at sales conference.	• Medium	• 06/29/88

Views. Looking at the same information through different views gives you a more informed perspective.

more on using and acting on your information. And less on processing it.

How does Agenda work?

First, enter your items of information into your PC and assign them to categories that you create.

The whole idea behind Agenda is to get them all in a row.

Then Agenda will do all of your filing automatically. And thanks to Agenda's *multiple filing capabilities*, if the information is relevant in more than one place, Agenda will take it and put it in several categories at once.

This makes it easy to view your data in different ways so you can pinpoint information that's important to you. Or discover new relationships you hadn't considered before. And anytime you change an item in a view, Agenda will automatically update all other categories where the item has been assigned.

In fact, you could say that Agenda recalculates your text the way a spreadsheet program recalculates numbers.

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* EDITOR'S CHOICE 9/15/86

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110SE	Miniature UPS for Macintosh SE or PLUS
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520ES *	For NetWare, VINES, and 3-COM file servers
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*These models provide interface for use with optional interface kits.

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CIRCLE 281 ON READER SERVICE CARD

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BUILDING WORKGROUP SOLUTIONS

Photograph, Jook Leung

3COM's 3+OPEN LAN MANAGER

The first implementation of Microsoft's OS/2-based *LAN Manager* network operating system forces Novell loyalists to sit up and take notice.

When Microsoft, IBM, DEC, NCR, 3Com, DCA, Torus, and a score of other companies back a single product, it's a good bet that that product will be important. The recipient of these companies' support right now is *LAN Manager*, a network operating system jointly developed by Microsoft and 3Com Corp. that will be sold by many companies under their own labels. 3Com, which shipped the first *LAN Manager* package last October, calls its version *3+Open LAN Manager*.

This review looks at the first release of *3+Open LAN Manager*. Another release, due in the first quarter of 1989, should incorporate more features and flexibility (see the sidebar "The Rest of the Story"). But even in its earliest release, *3+Open LAN Manager* poses a serious challenge to Novell's *NetWare* in the PC LAN market. *3+Open LAN Manager* performs well, has a good selection of LAN management functions, and is compatible with all of the LAN application programs marketed today that follow DOS 3.1 procedures. Its only major drawback is that it gobbles server RAM like a whirlpool sucking in seawater. The same reason that *3+Open LAN Manager* devours RAM, however, also makes it a good platform for growth: it works in conjunction with OS/2.

3+Open LAN Manager is the first network operating system that allows users to mix DOS workstations with OS/2 servers. OS/2 is required only on machines acting as servers in a *3+Open LAN Manager* network. Client workstations can use OS/2, but workstations using plain old MS-DOS also function well. The file server software uses OS/2 as its filing system in the same way that Novell's *NetWare* and Banyan's *VINES* use a proprietary operating system and Unix as the respective filing systems

THE REST OF THE STORY

Utilities designed by 3Com to be used with 3+Open LAN Manager promise to be as innovative as the operating system itself.

3Com is developing a line of utilities to augment its *3+Open LAN Manager* network operating system in the tradition of the dozen or so utilities available for earlier *3+* systems. Here are previews of five utilities in various stages of development, including *3+Open LAN View*, one of the first application programs to require the OS/2 Presentation Manager.

3+Open LAN Manager Utilities: Soon to Come

Utility	Shipping date	Expected price
3+Open Start	December 1988	$295 per network*
3+Open Mail	1st quarter 1989	$995 per network
3+Open Internet	1st quarter 1989	$995 per network
3+Open Secure	1st quarter 1989	$995 per network
3+Open LAN View	1st quarter 1989	$495 per server

*Actual price

3+OPEN START *3+Open Start*, which resembles *3+Start*, lets you log on without a boot disk so that you can use diskless workstations in your network. Centralized booting simplifies revision of network drivers, the operating system, the redirector, and other boot software. It conserves disk space, since you need only one start volume for all public users (those using special CONFIG.SYS files and user-specific TSRs still need private volumes), and it logs bad passwords.

When you turn on a diskless 3Com 286-based workstation, it automatically calls the server, where *Start* initiates the log-on. To use non-3Com workstations, you must plug in a $49 Etherstart PROM.

When setting up *Start*, you can specify user name, home server, home server security (user or share), and password. You can alter the defaults for maximum volumes, users, and receiving buffers.

3+OPEN MAIL Like *3+Open Start*, *3+Open Mail* resembles its *3+Mail* predecessor and includes a similar user interface. It works seamlessly among DOS, OS/2, and Macintosh workstations.

Services include send, receive, forward, reply, print, and transfer of binary and text files. You can file, arrange, and locate messages in electronic folders.

Auditing facilities consist mainly of audit logging, alert on audit, and alert on error, along with keeping track of the number of threads available to client machines, number of mailboxes assignable to server, and timing of various services. These include storing and forwarding, accessing other servers and accessing remote servers.

3+Open Mail offers *3+*'s Name Service, which extends the *LAN Manager* server naming feature to networks with e-mail and communications. Users can transparently access resources across large or internetworked systems. Administrators enjoy central entry and control of changes and additions to network resources and users.

3+OPEN INTERNET *3+Open Internet* enhances *3+*'s Route service. *Internet* combines remote internetworking, remote PC access, and internetwork bridging. All this is done transparently because *Internet* extends *Mail*'s Name Service beyond the boundaries of a given network. Directories, files, printers, e-mail recipients, and groups of recipients are all accessed by name, regardless of location.

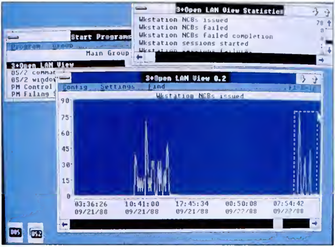
Internet adds many features. Configuration access can handle nonstandard modems (such as the Telebit Blazer). It has COM port management, including one-way port operation where needed, such as those for remote PC users. In/out provisions protect security; additional reporting capabilities handle connection statistics, traffic logging and report generation, *LAN Manager*–compatible audit trails and error logging—all at user-specified intervals.

Internet also supplies *LAN Manager*'s START, STOP, PAUSE, CONT, and alert services. A set of open APIs (Application Program Interfaces) aids those developing special applications, such as a weekly report statistically analyzing phone use. The user interface is consistent with IBM SAA and *LAN Manager*.

---

on their servers. All of these network operating systems either can or (in the case of *VINES*) will soon be able to support both DOS and OS/2 client workstations on the same LAN.

Because *3+Open LAN Manager* uses the multitasking OS/2 operating system on the server, it avoids the problems inherent in older operating systems. 3Com's *3+Share* and IBM's *PC LAN* are forced to augment or modify DOS to get it to do more than one thing at a time. Through OS/2, *3+Open LAN Manager* also carries the promise of supporting new, distributed-computing applications that share the



3+Open LAN View, *a utility for* 3+Open LAN Manager *designed to monitor network activity, will be one of the first applications to take advantage of the power of the OS/2 Presentation Manager. It is set to debut this spring.*

Internet is capable of speeds of up to 19.2 kilobits per second over voice lines; it also allows bridging between Ethernet (coaxial cable and twisted-pair), Token-Ring and Apple LocalTalk networks.

Internet runs on any protocol stack that supports named pipes. You can set up routes to schedule communications throughout the week. COM port control can force both connect and disconnect overrides on the set schedule.

You can also open activity logs to users on a read-only basis. On-line traffic statistic viewing includes zooming in on entries for more detail, as well as NEXT and PREVIOUS by time stamp. Logs can be cleared by deleting them from disk.

3+OPEN SECURE *3+Open Secure* adds password dating and enhances network resource management. Administrators can create a customized password-control program that forces users to change their passwords, giving them as many warnings as desired. *Secure* also tracks and logs network resource access and use, focusing on security issues such as invalid attempts to log on to the network and printer use.

Secure also converts *LAN Manager* audit trail data into other formats for analysis, accounting, or storage.

3+OPEN LAN VIEW *3+Open LAN View* demonstrates how the OS/2 Presentation Manager can be used in an application. Its graphical interface gives administrators a kind of instrument panel with which they, in effect, can fly their networks in real time. To some degree, *LAN View* even duplicates the kinds of services supplied by costly network analyzer programs. Because of the graphical interface, a mouse is a necessity.

LAN View gives you a graphical view of server statistics relating to performance, use, security, and network errors. You can view statistics as they occur or from a file. Errors can be viewed serially or ordered logically. You can also make current-historical comparisons. Files can be converted into *1-2-3* or .DIF formats.

Though *LAN Manager* collects data automatically, *LAN View* can force it to do its collecting on any schedule you choose.

A click-and-zoom process selects and expands on-screen windows. The audit trail includes time of errors to help isolate trends before they become crises. *LAN View* also tracks utilization of printers and servers. This aids planning for deployment of resources and helps determine new-equipment needs.

Many of *LAN View*'s features—such as Overview, which assembles all the network data onto one screen, Find Minimum/Maximum of a data set, and on-line help—have yet to be implemented, but what we did see strongly suggests that *LAN View* will be more than just a pretty interface that fills screens with colorful clutter. It uses the Presentation Manager's graphical capabilities in a thoughtful, functional way that should make network administrators' jobs both easier and more successful.—**Lee Thé**

Lee Thé is West Coast editor of PC Magazine.

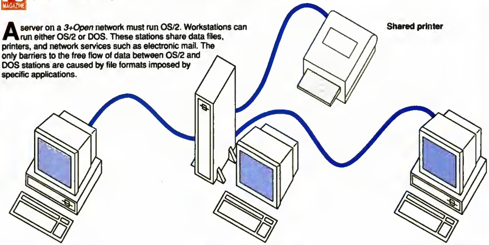
power of the servers and the workstations in ways that make sense. Except for a few database development systems that can assign some tasks to the server, you can't buy real distributed applications that use the OS/2 communications capabilities today, but many companies promise that they will eventually be available. When they come along, it will take a robust and flexible LAN operating system like *3+Open LAN Manager* to support them.

Developers have a wide choice of ways in which to use the LAN to communicate between nodes. These Application Program Interfaces (APIs) range from some

3Com's 3+Open LAN Manager Topology

(Ethernet or token-ring cabling and adapter cards)

A server on a *3+Open* network must run OS/2. Workstations can run either OS/2 or DOS. These stations share data files, printers, and network services such as electronic mail. The only barriers to the free flow of data between OS/2 and DOS stations are caused by file formats imposed by specific applications.



***3+Open LAN Manager* workstation**
- runs OS/2
- requires 2MB RAM and 80286 processor

***3+Open LAN Manager* server or server/workstation**
- runs OS/2
- requires 4MB to 5MB RAM and 80286 processor

***3+Open LAN Manager* workstation**
- runs DOS
- requires 105K RAM

that are unique to PCs, like NetBIOS, to others that work universally with machines from different manufacturers that have different operating systems and architectures, like TCP/IP and OSI.

It is clear that Microsoft and 3Com have put a lot of effort into making *LAN Manager*/*3+Open LAN Manager* appealing to software developers. These companies fully support international standards and promote easy program interfaces. We will see a quick outpouring of popular existing programs modified to make use of some level of these APIs, but it takes a couple of years for truly innovative programs to reach today's markets. *LAN Manager* should be a strong launching platform for the next cycle of important application programs.

NAMED PIPES One widely publicized *LAN Manager* API is known as named pipes. A named pipe is a software feature available on every *3+Open LAN Manager* node, even DOS-based workstations; it lets a program on one node invisibly communicate with programs running on other nodes. PC-based LANs can do this today using the NetBIOS services available on almost every LAN operating system. But the named pipes API is more sophisticated and much easier for programmers to implement than the NetBIOS interface. Additionally, named pipes should be faster than NetBIOS in some applications because the session between nodes is maintained through multiple transactions instead of through individually addressed blocks of data.

The power of named pipes is appealing, but its popularity isn't assured. IBM's system designers have a competing communications scheme called Advanced Program-to-Program Communications that is universal across their systems. There is also a growing number of application programs that directly address NetBIOS.

The number of companies marketing network interface cards compatible with *3+Open LAN Manager* and other *LAN Manager*–based packages should increase rapidly. Microsoft makes available a software kit for card manufacturers giving them all but about the last 2K of code they need to develop *LAN Manager* NetBIOS, TCP/IP, and OSI interfaces for their products. This should make it easy for the many companies that now support only their own software or *NetWare* to enter the *LAN Manager* product fold.

THE 3+OPEN PACKAGE With the potential of *3+Open LAN Manager* as background, let's turn to what it delivers today. 3Com markets *3+Open LAN Manager* through its direct sales force and through retailers. You can buy the product packaged several different ways, but all of the options include OS/2 for the server.

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PC MAGAZINE EDITOR'S CHOICE

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PC Magazine Editor's Choice Award, 4/26/88.

CIRCLE 737 ON READER SERVICE CARD

The *3+Open LAN Manager* entry-level system carries a $995 price tag. The only real limitation of this system is that it has a one-server, five-user license. The *3+Open LAN Manager* advanced package includes a one-server, unlimited-user license and retails for $2,995. You can upgrade the five-user package to unlimited users, or you can upgrade the network by adding an unlimited-user server and keeping the five-user server. The only thing you cannot do is add a second five-user server to the LAN.

If you have a 3Com 3S400 server, the *3+Open LAN Manager* package for this machine retails for $3,495. However, the package also includes standard DOS and an eight-user DOS license to support diskless workstations. The software for the 3S400 package comes on tape, and loading it is easy.

The price of *3+Open LAN Manager* includes only software. You also need network adapter cards for each server and client workstation. 3Com sells its EtherLink II cards for $445. PC-bus workstations and servers for small networks can use these cards, but busier servers benefit from 3Com's EtherLink Plus card that carries more memory and uses a 16-bit AT-bus interface. The EtherLink Plus sells for $895. An EtherLink Micro Channel card sells for $595.

Besides the software and the adapter cards, you will have costs for cabling and probably costs for upgrading the RAM in each server. The cable costs can be less than a dollar a foot if you do it yourself, but the cost of RAM may be a more significant figure. The *3+Open LAN Manager* LAN operating system and OS/2 require an absolute minimum of 4MB of RAM in each server. An added megabyte or two of RAM lets you configure larger buffers and disk caches; it also promotes faster operation. If you want to use the server as an OS/2 workstation simultaneously, you need yet another megabyte to run applications. You should consider the current price of RAM before you add up the price of a *3+Open LAN Manager* server.

As you plan your LAN, you should also know that the *3+Open LAN Manager* servers can operate with existing servers and workstations that use IBM's *PC LAN* software. IBM and 3Com have also demonstrated compatibility between IBM OS/2 Extended Edition and *3+Open LAN Manager*. If you have *PC LAN*, you can add a *3+Open LAN Manager* server without changing the workstation software and, if you wish, retain any existing *PC LAN* servers on the network.

FACT FILE

3+Open LAN Manager
3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(800) NET-3COM
(408) 562-6400

List Price: Entry-level package (one server, five stations), $995; advanced package (one server, unlimited users), $2,995; 3S400 package (with DOS and eight-user DOS license), $3,495; EtherLink II card, $445; EtherLink Plus card with 16-bit interface, $895; EtherLink Micro Channel card, $595.

Requires: 80286 or 80386 processor in server, 4MB RAM per server, 3MB RAM per OS/2 workstation, 640K RAM per DOS workstation, OS/2 (included for server, required for OS/2 workstations).

In Short: A strong new OS/2-based LAN operating system with good performance, support for old applications, and openness for new developments. Very RAM hungry (and therefore potentially expensive to set up), but a great platform for new distributed applications.

CIRCLE **699** ON READER SERVICE CARD

The *3+Open LAN Manager* package contains ten manuals and the disks. The entry-level system comes with 5¼-inch floppy disks, but you can trade those for 3½-inch disks if you need them. The *3+Open LAN Manager* advanced package comes with both disk sizes.

The documentation is excellent. The "3+Open LAN Manager/LAN Manager Installation and Setup Guide," complete and well-written, spells out every detail of the installation in 80 pages. All of the manuals use flow charts, screen diagrams, and step-by-step instructions to lead you through the installation and management of OS/2 and the network.

Installing OS/2 on the server is as easy as installing DOS. The version of OS/2 supplied with the first release of *LAN Manager* has some capabilities that won't be seen until later releases of Microsoft's multitasking operating system. These include disk caching, using hard disk partitions of up to 4 gigabytes, and a maximum file size of 2 gigabytes. The version of OS/2 you get with *3+Open LAN Manager* is licensed for installation only on the network server. If you want to set up OS/2 workstations, you should buy additional copies of the operating system for those nodes.

INSTALLATION DECISIONS During the installation, you have to decide if you want to dedicate the computer as a server or give it the ability to function as both a server and an OS/2 workstation. You also must choose between one of two types of security schemes. Finally, you have to determine what network protocols you want to use. The manual explains these decisions, and you should consider them beforehand; if you make the wrong choice, you might have to reinstall both the server and workstation LAN software.

The dedicated/shared server choice is more complex with an OS/2-based system than with a DOS-based system. Getting dual use out of a DOS-based PC usually means that both LAN and local operations run equally poorly. It also means that the server is always in danger of being locked up by a local application or an accidental reset. The logical conclusion is that a shared DOS-based server makes a poor choice in any but the most lightly loaded networks.

Under OS/2 the danger of locking up the entire machine is very small. The operating system handles multiple accesses, so the decision between dedicated and shared operation hinges on competition for the disk drive between local and network programs, the availability of RAM, and security. The security issue might be important in some installations because the local user has access to all files on the machine without going through network security. We configured our server for dedicated operation, but using a fast 386-based PC as both a server and a workstation is a reasonable proposition while working under *3+Open LAN Manager*.

3+Open LAN Manager will operate under either of two security arrangements.

Finally, a PC network that's fast and friendly.

A lot of people choose the TOPS/DOS network for its friendly menu-driven interface. Some for its raw Ethernet® speed. And some buy TOPS for the best reason of all…it's both fast *and* friendly.

TOPS Tech Specs.

- Requires one of following–3COM EtherLink II, 3COM EtherLink MC, TOPS FlashCard, or SynOptics LattisNet–to run on any IBM PC, PS/2 or compatible
- Compatible with many DOS 3.1 or NETBIOS-compatible LAN applications, such as dBASE III LAN, WordPerfect 5.0 LAN, Microsoft Word Network, and Q&A 3.0 Network.
- All TOPS network functions can be accessed from the DOS command line
- Can be configured in Client-only (120K) or Client/Server (190K) modes

As with all TOPS local area networks, TOPS/DOS requires virtually no training. With just a few simple menu selections you can quickly access other PCs, exchange files, and share peripherals as if they were your own. To install one yourself, just plug in a network card, your TOPS software (only 2 disks), and some very basic network cabling. No central server is needed, but you can easily add one as your needs grow.

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For instance, if you're currently linked via coax or modem but you plan to switch to a LAN, EXTRA! gives you the freedom to connect all three ways. And that includes LANs using IBM's Token-Ring Interface Coupler (TIC).

It's flexibility like this that prompted *PC Magazine* to name EXTRA! as its Editor's Choice for PC-to-host software running on LANs.

There's something else we don't want you to forget about EXTRA! It's your memory. EXTRA! uses so little of it, you'll have plenty of RAM left on your PC.

Plus, Attachmate's devotion to total IBM® compatibility assures you that you'll never get dead-ended by proprietary protocols.

Which reminds us of something else Houdini used to say, *"Don't get into anything you can't get out of later."*

PC MAGAZINE EDITORS' CHOICE 12/13/88

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CIRCLE 124 ON READER SERVICE CARD

LAN Operating Systems: Summary of Features

(Products listed in ascending price order)

This features table presents a brief comparison of 3Com's *3+Open LAN Manager*, IBM's *PC LAN*, and Novell's *Advanced NetWare*. The list of features was chosen to emphasize differences among them.

Peer-to-peer resource sharing indicates whether the networking software will let all nodes share resources with the network, and **dedicated server required** tells whether one computer has to be designated as the server. Technically, you could create a network of machines configured as *3+Open LAN Manager* server/workstations, but the cost for software and RAM would be high.

Since both *3+Open LAN Manager* and *NetWare* are rich in features and exhibit strong performance, factors such as support from local systems integrators and the software vendor become important.

The cost of these programs is difficult to compare directly. The basic *3+Open LAN Manager* advanced package has a price of $2,995, while the price of an equivalent Novell *Advanced NetWare* package is $2,695. IBM's *PC LAN* is priced at $235 per node, but you also need a $180 LAN support program for each node. Bear in mind that *3+Open LAN Manager* and *PC LAN* do not include electronic mail, while *NetWare* does. In addition, *3+Open LAN Manager* includes support for serial port sharing, which is implemented quite differently under optional *NetWare* software packages.

GENERAL INFORMATION	PC LAN	Advanced NetWare	3+Open LAN Manager
List price	Per node: $235 plus $180 LAN program	$2,695	$2,995 (advanced package)
Peer-to-peer resource sharing	●	○	●
Dedicated server required	○	●	○
SERVER SOFTWARE			
Operating system	DOS	Proprietary	OS/2
Minimum RAM required	640K	640K	4MB
Maximum number of cards bridged	2	4	4
Accepts Token-Ring cards	●	●	●
Operates across Token-Ring bridges	●	●*	●
Accepts Ethernet cards	●†	●	●
Accepts ARCnet cards	●†	●	●‡
WORKSTATION SOFTWARE			
Compatible with OS/2 workstations	○	●	●
RAM consumed by DOS workstation	24K–150K	15K–35K	105K–197K
NETWORK ADMINISTRATION			
Keeps historical error/status log	●	●	●
Accrues costs by resource	○	●	○
Suspends workstation on error	●	●	●
Reports bad packets and errors	●	●	●
SECURITY			
Access to resource according to group membership	○	●	●
Resource password protection	●	○	●
Access controlled by date and time	○	●	○
PRINTER SHARING			
Print spool hunts for appropriate printer	○	○	●

●–Yes ○–No

* Requires special gateway arrangements.

† Requires DOS NetBIOS from card vendor.

‡ Requires protected-mode NetBIOS interface.

In either scheme, the software monitors only passwords, without encrypting the contents of network transmissions. The first system, called user-level security, assigns a password to resources like disk drives, I/O ports, or anything you designate with a network name. This scheme is typical of DOS-based networks, particularly those using the older Microsoft *MS-Net* software. It is flexible, yet it can be very specific because each user can theoretically have a unique password for each resource.

The second security scheme, called share-level security, is more typically associated with minicomputer multiuser operating systems. Each user is given membership in one or more groups. The access rights and security restrictions of the group determine the individual rights. This arrangement is generally considered better

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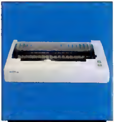

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for larger networks because it simplifies departmental and workgroup file management. *3+Open LAN Manager* modifies the typical share-level arrangement by making it possible to deny a specific user access to a resource otherwise available to the group.

The third decision you must make when you install *3+Open LAN Manager* is which protocol software you want to use to transmit messages across the network. Microsoft and 3Com products typically use a protocol called Xerox Network Services (XNS) to transport and receive data across the LAN. XNS is a widely supported protocol, and network devices such as bridges and routers from many different companies use it. IBM, however, uses a different protocol called Data Link Control (DLC) under their all-encompassing Token-Ring architecture.

To ensure compatibility with IBM Token-Ring installations, *3+Open LAN Manager* and other *LAN Manager* packages include the DLC protocols as an installation option. DLC messages can travel across IBM Token-Ring bridges. You probably need to take only the DLC option if you plan to use Token-Ring cards in an IBM wiring scheme.

Since having flexibility is better than a forced either/or choice, 3Com announced that the second release of *3+Open LAN Manager* will have a feature called "Protocol on Demand." This feature, according to the announcement, recognizes the protocol needed in a particular situation and supplies it.

Before you start your *3+Open LAN Manager* installation, you should decide what networking cards you will use. *3+Open LAN Manager* contains software drivers for Ungermann-Bass, Sytek, IBM, and 3Com cards of various kinds. You select the appropriate drivers when you install the server and workstation software.

A *3+Open LAN Manager* server can use up to four network interface cards in a server internal bridge. This allows you to mix and match cards and media inside the server to accommodate existing networks and different physical layouts.

After you have answered the final server installation questions, the *3+Open LAN Manager* installation software copies files to the appropriate drive and modifies the server's CONFIG.SYS, STARTUP.SMD, and initialization batch files for each session.

Once you install the server software, you run through similar menus and decisions to create the client workstation software. One nice feature of the installation software is that it is self-configuring for the video adapter in each station. The amount of memory used by *3+Open LAN Manager* on a DOS workstation varies according to the protocol and other services you install. In the first version of the software, the protocol driver and redirector take about 105K of RAM. If you add named pipes and other services, you can lose over 200K of RAM to networking software on a DOS workstation.

■ *3+Open LAN Manager* includes several management screens that help users access shared resources and help the administrator regulate the users.

The people at 3Com are sensitive to the problem of using memory in DOS workstations. If you run a DOS-based workstation with an 80386 processor, you can have a special device driver load most of the software into high memory. The exact amount of RAM you save depends on how much memory is taken by video and other high memory functions. In a later release, 3Com will deliver a smaller protocol driver and DOS requester that could reduce the memory requirement to as little as 35K.

Installing *3+Open LAN Manager* isn't difficult. An experienced person can do the job in half an hour, and someone with IBM *PC LAN* or Novell *NetWare* experience can install the system after spending an hour or so with the manuals. Nothing replaces a company-run school as a confidence builder, however, and 3Com runs courses on network installation and management in training centers across the country.

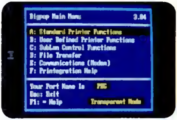
MANAGEMENT *3+Open LAN Manager* includes several management screens that help the users access shared resources and help the administrator regulate the users. These menus conform to IBM's Systems Applications Architecture. This means the menus are highly graphic, and many people will find it easier to use them with a mouse than with a keyboard. You can control all the resources and make all the connections in a network using the menus, but if you like to use batch files to control things, *3+Open LAN Manager* has a command language, too.

The popularity of IBM's *PC LAN* networking software and the related *MS-NET* products marketed by other companies led to the adoption of the *MS-Net* command language in the industry. This command language contains commands such as NET USE and NET SHARE and a concept called SHARENAME. NET SHARE makes a resource available, NET USE links a workstation to the available resource, and SHARENAME introduces a handy way to refer to a resource. For example, the sharename feature lets you share files on the server by calling them ACCOUNTS instead of something like SERVER1\D:\DBMS\ACCNTG\PAYABLE\JUNE. If you want to use the sharename feature, *3+Open LAN Manager* works with the same command language syntax as IBM's *PC LAN*.

3+Open LAN Manager does an excellent job of handling shared printers. Microsoft and 3Com learned from some of the problems people experienced with shared printing under early versions of *MS-Net*. The print-job-management capabilities of *3+Open LAN Manager* include the standard capabilities like prioritizing and managing the jobs in the print queue. You can also control form-feeds and set the system to hunt for available printers for certain kinds of jobs. *3+Open LAN Manager* contains a PostScript despooler that makes it easy to use networked printers for desktop publishing.

Another interesting sharing feature lets serial devices like modems and scanners be pooled and shared across the LAN.

The new look in printer sharing pick your price/performance level



```
Bigpop Main Menu                 3.04
A: Standard Printer Functions
B: User Defined Printer Functions
C: SubLan Control Functions
D: File Transfer
E: Communications (Modem)
F: Printegration Help
Your Port Name Is   PMG
Esc: Exit
F1: = Help          Transparent Mode
```

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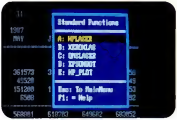
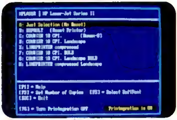


```
Standard Functions
A: HPLASER
B: XEROXLAS
C: QMSLASER
D: EPSONDOT
E: HP_PLOT
Esc: To MainMenu
F1: = Help
```

Select the exact printer control functions for your application.

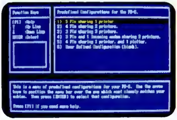


```
HPLASER | HP Laser-Jet Series II
A: Just Selection (No Reset)
B: DEFAULT   (Reset Printer)
C: COURIER 10 CPI.       (Roman-8)
D: COURIER 10 CPI. Landscape
E: LINEPRINTER compressed
F: COURIER 10 CPI. BOLD
G: COURIER 10 CPI. Landscape BOLD
H: LINEPRINTER compressed Landscape

[F1] = Help
[F3] = Set Number of Copies   [F5] = Select SoftFont
[ESC] = Exit

[F6] = Turn Printegration OFF        Printegration is ON
```

HP LaserJet Series II ™ resident selections are a keystroke away, no matter what application you're using. (This capability is available for every major brand of printer.)



```
Function Keys     Predefined Configurations for the PD-6.
[F1]  Help        1) 5 PCs sharing 1 printer
↑     Up Line     2) 4 PCs sharing 2 printers.
↓     Down Line   3) 3 PCs sharing 3 printers.
ENTER Select      4) 3 PCs and 1 incoming modem sharing 2 printers.
                  5) 4 PCs sharing 1 printer, and 1 plotter.
                  6) User Defined Configuration (blank).

This is a menu of predefined configurations for your PD-6. Use the arrow
keys to position the menu bar over the one which most closely matches your
needs. Then press [ENTER] to select that configuration.

Press [F1] if you need more help.
```

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Copies	Y (collated)	Y		Y
Popup operations, RAM resident and non-resident	BigPop	SmallPop		LaserPop
Job Cancel	Y	Y		Y
Automatic form feed	Y	Y		Y
Laser tray/forms control	Y			
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Text enhancement	Y			
Font management	Y			
Resource utilization reports	Y			

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Benchmark Tests: 3Com's 3+Open LAN Manager

These benchmark tests were run for both *3+Open LAN Manager* and *NetWare* using an IBM PS/2 Model 80 with 6MB RAM as the server. It was equipped with a 3Com EtherLink II network interface card, and the workstations were Dell System 200 PCs running at 12 MHz (with an 8.33-MHz data bus speed) using 3Com EtherLink II network adapter cards. All the tests were run using the same server, workstations, and thin Ethernet cabling. The top 3MB to 4MB of RAM in the server were not used by *NetWare*.

Results are reported in terms of throughput, measured in kilobits per second. These results were derived from repeated runs using files of 1MB and larger.

Both *3+Open LAN Manager* and *NetWare* benefit from well-designed disk caching programs. We opened up the *3+Open* cache and ran nearly 1.5MB of RAM for cache; this significantly improved performance. Utilities in both LAN operating systems reported that requests were met from cache approximately 80 percent of the time during these tests.

The performance of *3+Open LAN Manager* versus *NetWare* has been a hot topic of discussion at trade shows and on electronic forums such as *PC Magazine*'s PC MagNet. Microsoft and 3Com published test results demonstrating that the operating systems were nearly equal in many tasks. Yet our test results show that while the combination of OS/2 and *3+Open LAN Manager* performs well and is likely to satisfy the needs of the most sophisticated LAN designer, it does not match the top-speed performance of *NetWare*.

Note that LAN operating systems like *3+Open* and *NetWare* now turn out performance that is five to seven times faster than the majority of DOS-based LAN operating systems. And many of these DOS-based systems, like IBM's *PC LAN*, serve in large networks supporting many happy users. Throughput rate isn't everything, but it is one important—and measurable—factor.

Throughput Tests
(Results given in kilobits per second)

Network Throughput Under Load	**Zero stations**	**One station**	**Two stations**	**Three stations**	**Four stations**
NetWare, Version 2.12	763.2	744.7	710.3	646.7	626.9
3+Open LAN Manager (1,024K cache)	587.9	563.7	512.0	458.5	407.3
3+Open LAN Manager (640K cache)	531.9	516.3	478.1	428.2	360.2

Hard Disk Access Load	**Zero stations**	**One station**	**Two stations**	**Three stations**	**Four stations**
NetWare, Version 2.12	763.2	714.4	722.8	664.2	620.6
3+Open LAN Manager (1,024K cache)	587.9	531.9	485.7	428.2	375.4
3+Open LAN Manager (640K cache)	531.9	476.3	451.8	402.9	365.4

Database Load	**Zero stations**	**One station**	**Two stations**	**Three stations**	**Four stations**
NetWare, Version 2.12	763.2	731.4	735.8	714.4	694.2
3+Open LAN Manager (1,024K cache)	587.9	399.0	373.5	346.1	311.4
3+Open LAN Manager (640K cache)	531.9	330.3	282.5	269.5	220.5

The PC Labs LAN benchmark tests are written in C and are independent of commercial software. Each load station operates at a rate many times that of a PC in a typical heavy-use environment (such as a data entry operation). We have designed these tests so that a single station represents five to ten times the load of a user performing an interactive task (such as updating records) on a typical network.

The **Network Throughput Under Load, Hard Disk Access Load,** and **Database Load** benchmark tests each report the throughput recorded during the performance of a standardized task on the network. To obtain the figures shown here, we run a test program performing a sequential create, a sequential read, a sequential write, a random read, and a random write of a large file. The record sizes used in these activities systematically rotate among 16K, 4K, and 512 bytes. The results shown represent the average throughput over a period of time sufficiently long to ensure consistency. Usually a 1MB file is used, but this size may be adjusted for unusually fast or slow networks.

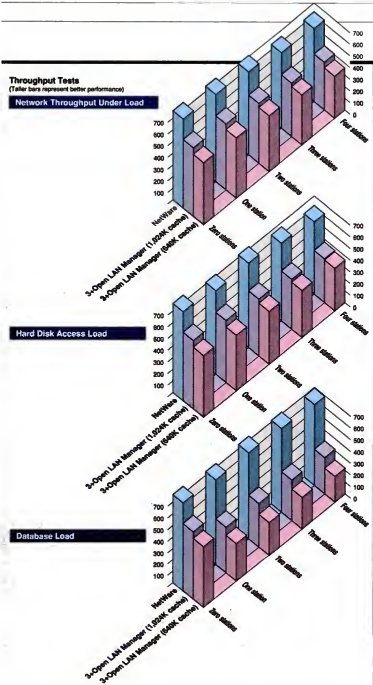
While the timed test is run, we load the network with other special programs. The **Network Throughput Under Load** test puts a heavy load on the network interface (cards, media, and access protocols) while placing a minimal load on the hard disk and file server software. In this test, each load station continuously reads and writes its own 1-byte data file, changing the data each time. This creates a high volume of data packets and strong contention at the network interface level.

The **Hard Disk Access Load** test heavily loads the hard disk and disk-caching system. Each load station randomly accesses its own 100K data file using a 1K record size. Data written to the file is changed each time. This test is influenced by the algorithms used in the cache scheme, the software's efficiency in handling the drive, and the speed of the drive and controller.

The **Database Load** test reflects the system's record-locking support and the way it handles a number of random simultaneous accesses to a common file. Each load station accesses a common database consisting of an index file and more than 4MB of data. Half of the accesses are a simple search of the index file with an accompanying access to a record in the data file. One quarter of the accesses perform the same operation but also lock the data record and update its contents. The remaining accesses update the index file and the data file. DOS 3.1 file- and record-locking calls are used.

Throughput Tests

(Taller bars represent better performance)


Network Throughput Under Load

Hard Disk Access Load

Database Load

That way, the serial devices can be addressed by an application program as if they were attached to a local serial port.

ADMINISTRATION You can administer a *3+Open LAN Manager* server from the server itself or from any workstation running OS/2 on the network. If your network has more than one *3+Open LAN Manager* server, you can create a separate OS/2 management session for each server on the management workstation.

3+Open LAN Manager contains good capabilities for monitoring and troubleshooting network operations. A display screen called Net Statistics reports data such as the number of I/O actions, active sessions, network errors, and even average response time. *3+Open LAN Manager* sends automatic messages to the administrator when certain problems such as an excessive number of bad password attempts occur or when a printer malfunctions. A feature called the Alerter service can forward messages to alert other users on the network when a problem pops up.

The network administrator has several tracking and recording tools, too. The Audit Trail service keeps track of who uses server resources and what kinds of actions they take. You can set up the audit log to record when users open files and access I/O ports. A real-time report on the active sessions is available to the administrator and shows who is connected to the server and how long the connection has been up and/or idle. An administrator can force a session closed to disconnect a user or free up resources.

While *3+Open LAN Manager* doesn't have some security and management features available in *NetWare* such as time-of-day/day-of-week log-in restrictions and cost accrual, it is powerful and flexible enough for the majority of large network installations. The screens and reports available are easy to use and should help administrators avoid problems or spot them before they grow.

PERFORMANCE The performance of *3+Open LAN Manager* (which will probably match that of other *LAN Manager*–based products, since most of the power of *3+Open LAN Manager* is contained in the core *LAN Manager* package) has already

■ 3+OPEN LAN MANAGER

become controversial because it is immediately compared with that of Novell's *NetWare*. Novell has objected that some of the early comparisons have been unfair.

Tests run by PC LAN Labs used all the same machines and the default installation procedures.

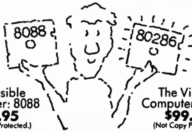
It is clear that *NetWare* outperformed *3+Open LAN Manager* in our tests. However, it is also clear that both operating systems are so far ahead of the rest of the pack in performance that which one finishes first isn't as important as the fact that these two are so clearly in the lead.

Potential buyers and resellers of these systems should regard the test results as proving that both operating systems give state-of-the-art performance. If you consider their performance adequate, then network decisions can be based on more important criteria such as application compatibility, support, flexibility, and cost.

> ■ The test results of *NetWare* and *3+Open LAN Manager* should be regarded as proof that both give state-of-the-art performance.

THE BOTTOM LINE *3+Open LAN Manager* is a young product, but the people behind it are skilled and have done their jobs well. It's obvious that *3+Open LAN Manager* is a powerful network operating system with enough features to please even the most jaded LAN administrator. The competition between *3+Open LAN Manager/LAN Manager* and *NetWare* will shake out and sharpen the marketplace. All buyers and most resellers will benefit from the renewed emphasis on standards and the room for innovation that *3+Open LAN Manager* brings. PC

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine.



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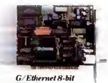

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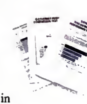

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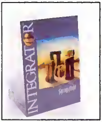

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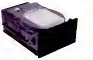

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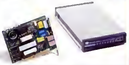

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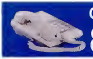

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FROM SCREEN TO SLIDE—AFFORDABLY

When companies want to dress up a presentation, they turn on the projector, shut off the lights, and show slides. The bright lines of text, the pie charts and bar charts, the painterly images that leap from their acetate surfaces onto boardroom or auditorium walls, are more compelling than anything a laser printer or a plotter can produce.

Slides, in a word, are entrancing. Some finance directors find slides so crucial to their message, in fact, that they'll spend thousands of dollars with a service bureau to make only 10 to 15 slides showing a month's progress in the annual plan. Some Fortune 1,000 companies order thousands of slides a week.

At a cost of $8.3 billion, U.S. businesses made 715 million slides last year, according to Hope Reports, a Rochester, New York, market re-

Tired of the expense and inconvenience of slide service bureaus? With today's affordable digital technology and the PC on your desk, why not create vivid, presentation-quality images yourself at a fraction of the cost?

search firm specializing in the media industry (see the table "Slide Production for U.S. Businesses"). Most computer-generated slides were made by contract production houses and computer service bureaus. But a proliferating new breed of quality film recorders costing less than $15,000—a bargain compared with the $25,000 to $125,000 price tag of earlier models—is making it possible for a growing number of companies to produce their own computer-generated slides.

MONEY SAVINGS Companies bring slide making in-house because it saves money. It costs $12 to $15 on average to produce only one slide through a service bureau—and that's if you create the image file yourself. If the service bureau designs the slide and shoots it, then the cost jumps to an average of $30 to $40 per slide (see the table "Service Bureau Costs for Designing and Producing Presentation Slides"). Rush orders or extremely complex graphics slides can cost more than $100 apiece.

Making a slide with your own film recorder, however, costs only 50 cents to $1—no matter how quickly it needs to get done or how artistic the image. For a 30-slide presentation the total savings would be at least $400, and could be as much as $1,200. Even if the cost of the film recorder and the labor expense of the person making the slides are factored into the equation, the costs are considerably lower than service bureau charges. The price of a film recorder can be recouped in just months, and the long-term savings are impressive.

Yes, service bureaus do have their place. They employ graphics artists who can design and execute unusual images or add creative flair to mundane ones. They have more expensive and capable equipment that enables them to do such things as "burn" a photo into an existing image, create a glow effect, correct the color of a scanned image, or use pin-registered cameras to produce multi-image shows. And they can handle the overflow at times of heavy demand (see "Slide Fare for the Common Man," *PC Magazine*, September 27, 1988, for a closer look at the merits of service bureaus).

But there are other reasons to make your own slides: you can retain control over sensitive information, work closer to deadlines, and keep slide shows up to date more easily.

Despite the obvious appeal of the medium and the overwhelming monetary argument for in-house use, very few film recorders have been sold to other than professional users. Film recorders, for one, are less convenient to use than other output devices. When a roll of film has been shot, you still have to send it out to be developed and mounted. You aren't immediately rewarded by an image—you don't even know if you have an image.

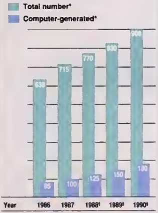
The resistance to film recorders will tend to soften as time goes on, especially when people see the wondrous slides they make with the high resolution now achievable in the lower-priced models. In addition, the graphics programs that create the slide images are becoming so friendly that casual users can produce persuasive, artistic images without long hours of reading the manual or taking a night course in graphics design.

A CLOSER LOOK The lower-priced film recorders come in a variety of shapes and sizes. Some are small and elongated—like shoe boxes that hold a size 28 shoe—and fit comfortably on a standard desktop. Others resemble large microwave ovens: bulky, a little on the heavy side, and not particularly suited for a desk that must leave room for other work. One, the PCR from Matrix Instruments, stands 3 feet tall and rolls around on wheels, like a rectangular-shaped canister vacuum cleaner.

There are three types of film recorders: analog, digital, and opto-mechanical. Analog recorders produce the lowest-quality slides because they use your monitor's video signal. It's as if you put your computer system into a darkened photographer's studio and set up a camera on a tripod in front of the monitor—except that in an analog recorder the monitor has been shrunk to the size of a package of floppies (or smaller), the photographer's studio is reduced to a box, and the camera has been bolted onto a peephole at one end. While manufacturers have managed to increase the number of vertical and horizontal pixels on the internal CRT, the optical resolution is still not much better than that of a VGA.

Slide Production for U.S. Businesses

The number of computer-generated slides created for business presentations is expected to increase gradually in the next few years.



Year	1986	1987	1988‡	1989‡	1990‡
Percentage computer-generated	13	14	16	18	20

* In millions
‡ Projected figures
Source. Hope Reports Inc., Rochester, N Y

Service Bureau Costs for Designing and Producing Presentation Slides*

Text with color background	$17
Bar charts and pie charts	$30
Text with graphics	$47
Illustrations with line art	$110

Source Genigraphics Corp., Liverpool, N Y
*Average price per slide

The analog film recorder uses a black and white CRT; in front of the CRT is a color wheel with red, green, and blue filters. As the camera shutter opens, the film is exposed to the image one color at a time. The first color pass is red, followed by green and then blue. All the film recorders come with 35mm cameras, and some let you attach 4- by 5-inch, 8- by 10-inch, or other cameras so that you can use different film types—including several instant-print films. The larger film types can be used to produce overhead transparencies.

The Polaroid Palette was one of the first relatively inexpensive analog film recorders sold for business applications. Today the Polaroid PalettePlus is about the only popular analog film recorder left on the market. Most other analog film recorders are sold as niche products, typically in the scientific and engineering fields.

Despite their relatively low resolution, analog recorders do have their pluses. For one thing, they are very fast—partly because of their low resolution and partly because the image is created all at once. Take the MultiColor analog recorders from Matrix Instruments as an example: these will produce about 120 slides an hour on 35mm film. In comparison, the digital PCR recorder from Matrix will shoot only 10 to 30 slides an hour, depending on the resolution you've picked. Because analog recorders use the same video signal as the PC monitor to get image data, they don't need special software drivers and will work with just about any application.

THE DIGITAL DIFFERENCE Digital film recorders are built very much like analog recorders. They too have an internal black-and-white CRT—typically 2 to 7 inches on the diagonal—and pass light through a color wheel with red, green, and blue filters to the film in a camera. The main difference is that the image on the film recorder's CRT is built up pixel by pixel and line by line from digital information passed through the computer's processor. This is the main reason that digital recorders are so much slower than their analog counterparts.

Since the digital information functions as instructions for recreating the object elements in the original graphic image, there is no theoretical limit to the resolution (sharpness) of the image. The computer will tell the recorder's CRT, for example, that on line 1 the first group of pixels are black, followed by so many pixels of red, then green for this many pixels, and so on across the line.

Most digital film recorders can now shoot at what the industry refers to as 4,000 lines, or 4K resolution. These numbers refer to the horizontal measure of resolution—the full measure of 4K resolution is 4,096 pixels across by 2,732 pixels vertically. Because of the size of 35mm film, the horizontal measure is larger, and manufacturers like to quote the higher-resolution number.

Digital film recorders usually require adapter cards and need software drivers to work with graphics programs. Many graphics packages now have drivers for several film recorders, but none have drivers for every one. So it's important to know if your favorite graphics package has a driver for the film recorder you're interested in.

■ Most digital film recorders now shoot at 4,000 lines or 4K resolution, which refers to the horizontal measure of 4,096 pixels across.

Digital recorders work best for business applications because they can produce such high-quality slides. The slide presentations given in sales campaigns, marketing shows, or high-level corporate briefings need to be sharply focused and intensely colored for the proper impact.

Only one film recorder exploits optomechanical technology: the ImageMaker Plus, from Presentation Technologies. Instead of using an internal CRT, a beam of light from a halogen lamp is shot through a liquid-crystal shutter, a color filter wheel, and a removable font wheel to produce mostly text slides. For graphics it moves the camera lens so that the light beam traces images on the film, much as a plotter pen does on paper. This is its main failing: images can't be placed on top of one another, causing the graphics it produces to suffer.

But the ImageMaker Plus produces great-looking text. Because it uses a font wheel, the letters and numbers have very clear edges, even in the curves; it resembles a daisy wheel printer in this regard. Also, since it doesn't have a CRT, the image doesn't suffer from distortion. Even though digital recorders use flat-screen CRTs, unavoidable imperfections in the way a beam of light is deflected cause some linear distortion in the image.

IMAGE QUALITY Two factors primarily account for the quality of a slide image: resolution and color. This holds true for any type of film recorder.

The resolution of an image depends on the number of addressable pixels and the pixel size. When manufacturers talk about 2K (2,000-line) or 4K (4,000-line) resolution, they are talking about only the addressable resolution—that is, the number of discrete pixels along a line to which a beam of light can be directed. They dislike talking about the more important half of the resolution equation: pixel size.

Part of this reticence arises from the difficulty in measuring a pixel. Pixels do not have hard edges; they trail off like the sound of a plucked violin string, so it's hard to determine where the diameter starts and stops. In some cases, although the addressable resolution is 4K, the pixel size is too big to deliver this resolution. Pixel size is controlled by the quality of the electron gun in the CRT tube, the focus circuitry, the length of the tube, the size of the CRT and its quality, and the square inches of usable surface area on the tube.

If the pixel size is large, curving lines of text and image edges can appear jagged or fuzzy—even if the addressable resolution is 4K. So just knowing the addressable resolution will not tell you how good slides will appear when they are projected—there is still great variance in slide quality.

True 4K resolution—where the pixel size is small enough to actually fit 4,096 pixels on one horizontal line without over-printing—approaches the resolution limit of 35mm film that has a film speed of ASA/ISO 100. Kodak Ektachrome, with a film speed of ASA/ISO 100, is the film type that produces the best image in all film recorders because the manufacturers have calibrated their machines to suit the imaging characteristics of this film. The reason that they chose this film rather than, say, a Fuji ASA/ISO 50, which can produce sharper pictures, is that it's the most common film used to make slides. Every photo shop carries it. It is also a good quality film.

Some film recorders can be calibrated to handle larger film formats like 4 by 5 and 8 by 10 inches, which have a greater spot capacity. But only those recorders with an addressable resolution of 8K, such as the Mirus FilmPrinter and the high-end machines, can take true advantage of these film types.

Often the difference between 4K and 2K slides is hard to see. If you look carefully, you will notice that sweep backgrounds tend to have fewer color changes in 2K; borders to image elements seem thicker and fuzzier, and text seems less sharp. But the quality of the screen on which the image is projected—and the focus of the projector—can actually have more bearing on the overall image clarity than an additional 2K in addressable resolution.

QUICKER PRODUCTION IN 2K Because the quality difference between 2K and 4K is minor, some users record mostly in 2K, which takes much less time. A simple text slide of 6,140 pixels, for example, takes a bit over 2 minutes to record in 2K resolution with Matrix's PCR. In 4K resolution, the same slide takes close to 7½ minutes. If you multiply the difference by the 20 to 30 slides in an average presentation, it will take at least an hour and 40 minutes more to record in 4K than in 2K. Since presentations are often created in a rush, the time it takes to shoot can mean the difference between making or missing a deadline.

For extremely important presentations, however, people need the extra sharpness they can get from 4K. These presentations are bound to be made with higher-quality projectors, which make the faults of lower-resolution slides more apparent.

Although the difference between 2K and 4K, or one film recorder's slide and another's, may be hard to see at first, your eye will gradually become more sophisticated. Lower-quality images will appear crude and dingy compared with higher-resolution slides. In the end, people tend to shoot images in the best quality they can, given the time pressure they are under.

Slide quality is also affected by the color capacity of a film recorder. More colors mean a livelier slide or more realistic im-

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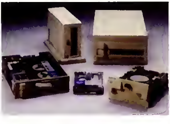

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ages. And producing smoothly graded backgrounds or three-dimensional illusions depends a great deal on the number of colors that can be imaged at once. The lower-priced film recorders now do a much better job with color than they once did. General Parametrics' PhotoMetric SlideMaker, for example, can put 1,000 colors on a slide at once, from a selection of 1,000. The Matrix line of digital film recorders supports 16 million colors, although a slide can have only 256 colors. The Lasergraphics Film Recorder supports the same number of colors as do the Matrix machines, but the LFR can record them all simultaneously.

> ■ Some users record in 2K, which takes less time than 4K. The time saved can mean the difference between making and missing a deadline.

The best way to judge quality is to test some of your own graphics images. Pick slides with different font styles and type sizes, sweep backgrounds, and lots of color. Some of the things you should look for in the slides are darkness in the corners, banding (or lines in the background), fuzzy or jagged edges, dull colors, waviness in broadly colored areas (particularly white), bleeding of color at the edges of objects, and bowing in or tilting out of image elements (pin cushioning).

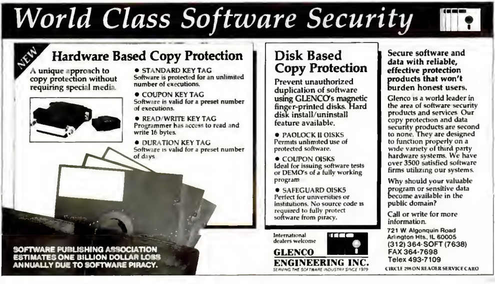
Using a film recorder is not difficult. Since you usually run it from the graphics program, all you may need to do is choose the film recorder's name off a menu of output devices and press a key to send it an image, much as you would send a document to your printer.

The controller software that comes with a film recorder can also be used to shoot image files—as long as they are in an acceptable file format. The Matrix film recorders, for example, require SCODL (Scan Conversion Object Description Language).

As an image is being recorded, you can generally tell what's happening through progress messages on the screen or LED lights on the recorder's front panel. Files can be recorded in batch, so whole presentations may be run at night. Many of the film recorders can use a bulk film pack attachment allowing you to shoot up to 100 feet of film—roughly 750 frames—rather than the typical 24 or 36 exposures on a standard roll of 35mm film. But you have to be doing a high volume of work to justify spending the extra money. A bulk film pack for the PCR recorder, sold by Double-M, a third-party supplier, costs $4,000.

WHAT'S REVIEWED For this story we looked at seven film recorders suitable for in-house slide production ranging in price from $2,999 to $14,290. With the exception of the Polaroid PalettePlus, we looked only at digital film recorders, which are generally more suitable for business applications. Because the PalettePlus has such a strong presence in business offices, we decided to compare its features with digital film recorders under $15,000.

When it comes to deciding which film recorder to purchase, everything pales before the quality of the image and the speed of operation. How many camera types you can use, how good the documentation is, whether you can run in background and foreground—these are all minor weights on the scales of judgment. How you balance the cost against differences in image quality and speed, as well as the other recorder attributes, is completely subjective. But we've tried to give you the information



you'll need to make this subjective evaluation on each of the actively marketed digital film recorders in the under-$15,000 price range.

One of the film recorders we looked at, the Mirus FilmPrinter, offers a variation on digital technology. Instead of adjusting the intensity or speed of the internal CRT light beam to get different colors, it rescans lines. This product, however, is so new that at review time we could test only an early production version. From what we saw, the FilmPrinter has the potential to be an excellent alternative to film recorders costing almost twice as much and taking up much more space (see the sidebar "The Mirus FilmPrinter Advances the State of the Art," for a more complete evaluation of the Mirus FilmPrinter).

We also looked at two nondigital recorders that have been important in the business market: the Polaroid PalettePlus and the ImageMaker Plus (discussed in the review of its new digital sister machine, the Montage FR1), from Presentation Technologies. The Palette, an analog recorder, was one of the very first film recorders to be introduced for desktop use. It has garnered broad support by producers of graphics software and is relatively inexpensive.

There are other analog film recorders that could be used for shooting business presentations. But in general, their image resolutions and color ranges are too limited to compete against the digital recorders. This is also true of the even more primitive, but similar, screen cameras (like the Datacam 35 from Photographic Sciences Corp.), that are attached to the front of your monitor and simply photograph a screen image.

Another desktop slide-making alternative to digital film recording is Polaroid's Bravo Slide Maker. The Bravo Slide Maker makes slides instantly from your hardcopy documents. Since you don't need a graphics package at all, the Slide Maker is quite handy if you need to throw together a slide show instantly.

An objective, numeric measure of quality is almost impossible because it is so difficult to measure pixel size and shape as well as the actual number of pixels that the film recorder can lay down horizontally and vertically.

But since the quality of the slides that film recorders produce is of primary importance, we devised several distortion tests to try to measure it.

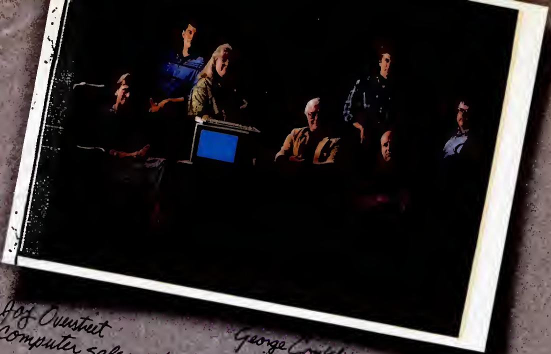
Because the objective measures can tell us only so much—and because what they tell us happens beneath the surface of the slide image—we also looked at quality subjectively. We had four slides designed and created for us—simple text (TEXT1), complex text (TEXT2), simple graphic (GRAPH1) and complex graphic (GRAPH2)—by Brilliant Images, a service bureau based in New York. The slides were shot with Matrix's QCR film recorder. To create the slides, Brilliant Images used *Mirage*, a graphics program from Zenographics that we then used to drive the film recorders.

Mirage is the Learjet of graphics programs. Although difficult to use, it produces extremely high quality graphics and has drivers for all the film recorders we reviewed—even the Mirus FilmPrinter, which was not yet shipping. Other graphics programs may not be able to take full advantage of a film recorder because of inherent limitations, such as their capacity for color.

We then showed the four slides shot by each film recorder to a panel of people in a realistic presentation environment. The slides were evaluated for general clarity and richness of color. They were also examined for over a dozen potential problems, such as banding (lines that reveal the transition from one color shade to another in what is supposed to be a smoothly shaded area), darkness in the corners, jaggedness in the curving edges of text, and so on. We also tested each recorder for the time it takes to shoot a slide. We found a tremendous variance in speed, and this can be important if you make a lot of slides or often have rush jobs.

The timed-test results, the quantitative distortion tests, the qualitative slide show results, the features table, and the reviews should help you make the right choice of film recorder. Bringing slide making in-house will give you much better control of your presentations and save you a great deal of money. In turn, you will probably make more slide presentations: their quality will astound you.

—Henry Fersko-Weiss



Digital Film Recorders: Summary of Features

(Products listed in ascending price order)

	Polaroid PalettePlus Polaroid Corp.	**Color Digital Imager IV** Bell & Howell Quietar Co.	**Montage FR1** Presentation Technologies	**PhotoMetric SlideMaker** General Parametrics Corp.	PC **Matrix ProColor** Matrix Instruments Inc.	**Lasergraphics Film Recorder** Lasergraphics Inc.	**Matrix PCR** Matrix Instruments Inc.
	$2,999	$3,995	$5,995	$6,190	$7,990 with MVP-PC board, $8,490 with MVP-Star board	$9,950	$13,790 with MVP-PC board, $14,290 with MVP-Star board
SPECIFICATIONS							
Type	Analog	Digital	Digital	Digital	Digital	Digital	Digital
Dimensions (HDW, inches)	6.3 × 7.8 × 16.5	13 × 10.3 × 18.5	6.5 × 14.5 × 17	6.3 × 14.5 × 16	10.4 × 14.7 × 20.5	8.5 × 9.8 × 22.5	35.8 × 11.5 × 17.7
Weight (pounds)	12	36	20	12.7	38	33	42
Cameras (with supported film speeds)							
35mm	Standard (ASA/ISO 40, 100, 200)	Standard (ASA/ISO 40, 64, 100)	Standard (ASA/ISO 100)	Standard (ASA/ISO 40, 64, 100)	Standard (ASA/ISO 100)	Standard (ASA/ISO 100)	Standard (ASA/ISO 100)
669 film transparency	Standard (ASA/ISO 80)	Standard (ASA/ISO 80)	Not available	Optional ($298, ASA/ISO 80)	Not available	Not available	Not available
339 film transparency	Optional ($300, ASA/ISO 640)	Not available	Not available	Not available	Optional ($1,095, ASA/ISO 640)	Optional ($1,000, ASA/ISO 640	Not available
Film							
Ektachrome	●	●	●	●	●	●	●
Polachrome	●	●	●	●	●	●	●
Kodacolor	○	○	○	●	○	●	○
Instant print	●	●	○	●	●	●	○
Other	Agfachrome, Fujichrome, Polaroid 691 Colorgraph	Fujichrome, 3M Colorslide CRT 100	Agfachrome, Fujichrome, Kodak VRG Gold 100	Polaroid 691 Colorgraph	Kodak Ektachrome Professional, Ektachrome 100 HC	Kodak VRG Gold 100, Polaroid 339 Professional	None
Internal CRT size (inches)							
Diagonal screen	3.00	3.00	2.87	3.00	7.00	6.00	7.00
Tube length	5.75	5.75	6.50	6.50	7.75	13.00	13.33
INSTALLATION							
Requires expansion board	○	○	●	●	●	●	●
DIP switches	N/A*	N/A*	○	●	○	○	○
Jumpers	N/A*	N/A*	●	●	●	●	●
Serial port	●	●	●	○	○	●	○
Parallel port	○	○	●	○	○	●	○
DOCUMENTATION							
Quick set-up guide	○	○	●	●	○	●	○
Diagrams	●	●	●	●	●	●	●
Tutorial	○	●	●	○	○	○	○
Index	●	○	●	●	●	●	○
Troubleshooting guide	●	●	●	●	○	●	○
OPERATION							
Film loading							
Self-loading	●	○	●	●	●	●	●
Automatic advance	●	●	●	●	●	●	●
Automatic rewind	●	○	●	○	○	○	○

PC —Editor's Choice ●—Yes ○—No

N/A*—Not applicable: this product does not need an expansion board

N/A†—Not applicable: analog film recorder takes image from monitor

	Polaroid PalettePlus Polaroid Corp.	**Color Digital Imager IV** Bell & Howell Quintar Co.	**Montage FR1** Presentation Technologies	**PhotoMetric SlideMaker** General Parametrics Corp.	**Matrix ProColor** Matrix Instruments Inc.	**Lasergraphics Film Recorder** Lasergraphics Inc.	**Matrix PCR** Matrix Instruments Inc.
	$2,999	$3,995	$5,995	$6,190	$7,990 with MVP-PC board, $8,490 with MVP-Star board	$9,950	$13,790 with MVP-PC board, $14,290 with MVP-Star board
OPERATION							
Calibration							
Automatic	●	●	●	●	●	○	●
How often	On power-up	Each exposure	Each exposure	Each exposure	Every 5 images or 15 minutes	Each exposure	Every 5 images or 15 minutes
Controller software							
RAM required	60K	11K	256K	384K	512K	256K	512K
Works in foreground	●	○	○	●	●	○	●
Works in background	●	●	●	●	●	●	●
Includes diagnostics	●	●	○	○	●	○	●
Menu-driven	●	●	○	●	○	●	○
Batch processing	●	○	○	●	●	○	●
Screen grabber	●	●	○	○	○	○	○
Software compatibility							
Graphics drivers	35	30	33	40	30	100	30
PostScript	N/A†	○	○	○	○	○	○
Targa support (TGA)	N/A†	○	●	○	○	●	○
File formats	N/A†	Native Graphic Primitive	Lasergraphics Language	NAPLPS	SCOOL	Lasergraphics Language, NAPLPS, PIC, GSSRCI	SCOOL
HPGL	N/A†	●	●	○	○	●	○
IMAGING							
Addressable resolution	640 × 700 pixels	2K	2K–4K	2K–4K	2K–4K	2K–4K	2K–4K
Limit of image file size	135K	Unlimited	Depends on memory available on interface card	100K	Unlimited	Depends on memory available on interface card	Unlimited
Number of colors supported	72	256,000	16 million	1,000	16 million	16.7 million	16 million
Fonts							
Number supplied	None	1	10	6	4	10	4
Number of additional fonts supported	None	17	None	None	20	8	20
Scaled sizes	○	○	●	○	●	●	●
Accepts software fonts	●	●	●	○	●	●	●
CUSTOMER SUPPORT							
Warranty period	90 days	90 days	90 days	90 days	1 year	90 days	90 days
Technical support	Vendor	Vendor	Vendor/3rd party	Vendor/3rd party	3rd party	Vendor/3rd party	3rd party
Service contract available	●	●	●	●	●	●	●
On-site repair	●	○	●	○	●	○	●

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Of products to go,
A gala selection
For beginners and pros.

☐ 3½" format available from us. Specify when ordering.
⊡ package includes both 5¼" and 3½" disks.
🅁 3½" format available from manufacturer by request. Call us for details.
CP—copy-protected, **NCP**—not copy-protected

SOFTWARE

We only carry the latest versions of products Version numbers in our ads are current at press time.

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through February 28, 1989

Chipsoft ... NCP
🅁 Turbo Tax Personal/1040

Tax time is here once again, and Turbo Tax is back with all the tools you need to make filing your federal tax return quick and easy. Included are over 40 forms, schedules, and worksheets, as well as an optional Visual 1040 mode (giving you a graphical representation of any form or schedule).

- Quick-Link forms finder to find forms by subject
- Pop-up calculator, notepad, and on-line IRS instructions
- Visual 1040 mode option allows you to fill out and view any form or schedule on screen
- New Auto-Interview to help you find the forms you need, and Data Examiner to help pinpoint omissions
- Prints IRS approved dot matrix 1040
- State tax packages also available

Turbo Tax Personal/1040	$43.
State Packages Personal/1040 6.0 . . .each	32.

Aldus ... NCP	
☐PageMaker 3.0	call
Alpha Software ... NCP	
☐Advanced Keyworks 1.0	$175.
⊡AlphaWorks 1.0 *(integrated package)*	115.
☐ALPHA/three 1.0 *(dB3 file compatible)*	219
American Small Business Computers	
☐Design CAD 3.1 *(NCP)*	159.
☐Design CAD 3D 1.1 *(NCP)*	159.
Application Techniques ... NCP	
⊡Pizazz Plus 1.12	75.
Ashton-Tate ... NCP	
☐dBASE IV 1.0	call
☐RapidFile 1.2	219.
⊡MultiMate Advantage II 1.0	299
☐Master Graphics 1.0	299
☐Framework III 1.0	459.
Autodesk	
☐Autosketch Standard 1.04	55.
Barron's ... CP	
🅁SAT *(Test preparation program)*	35.
Best Programs ... NCP	
☐Label Master 3.1 *(mailing label program)*	29.
☐Report Manager 5.0	199.
☐Fixed Asset System 5.0	359.
Bible Research ... NCP	
☐The Word 4.2 *(King James version)*	159.
☐The Word 4.2 *(New International version)*	159.
Bloc Publishing ... NCP	
☐FormTool 2.01	55.
☐Form Filler 1.5	89.
Borland International ... NCP	
🅁Turbo C Professional Pack *(includes Assembler)*	169
🅁Turbo Pascal Professional Pack *(includes Assembler)*	169.
⊡Paradox OS/2 1.0	479
🅁Prolog 2.0	99.
🅁Turbo C 2.0	99.
🅁Turbo Pascal 5.0	99
🅁Turbo Assembler & Debugger 1.0	99
🅁Reflex 1.1	99.
🅁Sidekick Plus 1.0	135.
🅁Sprint 1.0	$135.
🅁Quattro 1.0 w/SQZ!Plus 1.0	165.
⊡Paradox 2.0	call
🅁Turbo Editor Toolbox 4.0	69.
🅁Turbo Database Toolbox 4.0	69.
🅁Turbo Basic Editor Toolbox 1.0	69.
🅁Turbo Basic Database Toolbox 1.0	69.
🅁Superkey 1.1	69.
Bourbaki ... NCP	
☐1DIR + 3.0	49.
Bridgeway Publishing ... NCP	
☐FasTrax 3.9	35.
Broderbund ... CP	
☐Print Shop 2.41 *(includes Graphics Library 1)*	39.
☐Memory Mate 3.01R *(NCP)*	45.
Chipsoft ... NCP	
🅁TurboTax Personal/1040 6.0	special
🅁State Packages Personal/1040 6.0	special
🅁TurboTax Proseries/1040 5.0	229
Chronos Software ... NCP	
🅁Who•What•When *(people, projects, time)*	119.
Computer Associates ... NCP	
⊡SuperCalc 5 1.0	call
Core International ... NCP	
☐Corefast 2.0	95.
Crosstalk Communications ... NCP	
☐Remote² 1.01	$95.
☐Crosstalk XVI 3.7	95.
☐Crosstalk MK.4 1.1	124.
Dac Software ... NCP	
☐Dac-Easy Payroll 3.0	59.
☐Dac-Easy Light 1.0	45.
☐Dac-Easy Accounting 3.0	59.
Delrina Technology ... NCP	
⊡Per:FORM 1.0	159.
Digital Research ... NCP	
☐Gem Desktop 3.0	35.
☐Gem Draw Plus 2.01	189.
5th Generation ... NCP	
⊡Fastback Plus 2.01	109.
Fox Software ... NCP	
🅁Foxbase Plus 2.1 *(single user)*	209.
🅁Foxbase Plus 386 2.1	319.
Funk Software ... NCP	
☐Sideways 3.21 *(creates wide printouts)*	42.
⊡Worksheet Utilities 1.0 *(1-2-3 utilities)*	59.
⊡Inword 1.0	59.
☐Allways 1.0	85.
⊡Noteworthy 1.0	49.
General Information ... NCP	
☐Hot Line Two 2.0	57.
Generic Software ... NCP	
☐Generic CADD Level 1	35.
⊡Generic CADD Level 2	55.
⊡Generic CADD Level 3 *(now includes Dot Plot)*	135.
⊡3D Solids 2.2	189.
⊡Estimator	159.
☐Basic Home Design 3.0	35.
☐CADD Starter Kit *(contains Level 2, Home Design, Workbook tutorial, & sample disk)*	89.
Harvard Associates ... NCP	
🅁PC Logo 3.0	special
Hayes ... NCP	
⊡Smartcom II 3.0	89.
Hilgraeve Software ... NCP	
☐HyperACCESS 3.31	89.
Individual Software ... NCP	
⊡Typing Instructor Encore 2.13	26.
☐Professor DOS 2.51 *(with Smartguide)*	33.
🅁101 Macros for 1-2-3, WordPerfect, and others . . . *each*	42.
Intuit ... NCP	
⊡Quicken 2.0	35.
Javelin ... NCP	
🅁Javelin Plus 2.02	249.
Lotus ... NCP	
⊡Agenda 1.0	289.
☐1-2-3 2.01 *(upgrade free to version 3.0)*	call
☐Hal 1.0	109.
☐Freelance Plus 3.0	call
⊡Manuscript 2.0	359.

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If your workload's appalling

And the tax man is calling,
With programs like these
There's no reason for stalling.

T/Maker ... NCP	
🅁Scrapbook+ 1.0	$79.
🅁ClickArt Business Images	42.
🅁ClickArt Holidays	42.
🅁EPS (PostScript) Illustrations	79.
The XTREE Co. ... NCP	
⊡XTREE Pro 1.0	69.
☐Hot 4.0	95.
TOPS ... NCP	
Flashcard *(AppleTalk network card; 1 year warranty)*	169.
NetPrint 2.0 *(share printers)*	119
TOPS 2.0	119.
TOPS Repeater *(extends network)*	132.
Traveling Software ... NCP	
Battery Watch 1.0 *(3½" only)*	27.
⊡Laplink Mac 2.0 *(Mac-PC transfer)*	79.
⊡Laplink Plus 2.1	85.
⊡Desklink 2.21	99
True BASIC, Inc. ... NCP	
☐True BASIC 2.03 *(now includes Runtime)*	57.
🅁True Basic Libraries	32.
Vericomp ... NCP	
⊡SoftBytes 2.0	35.
WordPerfect Corp. ... NCP	
⊡WordPerfect Library 2.0	69
☐WordPerfect 5.0	239
🅁WordPerfect 5.0 Addit'l Network Stations	84.
⊡WordPerfect Office 2.0	269
🅁WordPerfect Office 1.0 Addit'l Network Stations	84.
⊡WordPerfect Network Server 5.0	349.
⊡WordPerfect Executive	129.
☐DataPerfect 1.0	299.
Wordtech ... NCP	
☐DBXL 1.2	119.
Xerox ... NCP	
☐Ventura Publisher 2.0	call
🅁Professional Extensions *(reqs. Ventura Publisher)*	call
XyQuest ... NCP	
☐XyWrite III Plus 3.54 w/A-la-Carte Menus	239.
⊡XyWrite III Plus Network Server 3.54	399

RECREATIONAL/EDUCATIONAL

Accolade ... CP *(reqs. graphics brd.)*	
🅁Bubble Ghost	22.
🅁Mean 18	29.
🅁Hardball *(baseball simulation)*	11.
🅁Testdrive *(driving simulation)*	24
🅁Jack Nicklaus' 18 Greatest Holes	29
🅁Grand Prix	22.
🅁4th & Inches *(football simulation)*	22.
Broderbund ... CP	
🅁Where in the World is Carmen SanDiego?	25.
🅁Where in the USA is Carmen SanDiego?	25.
🅁Where in Europe is Carmen SanDiego?	$29.
🅁Toy Shop	39.
🅁Ultima IV	35.
🅁Ultima V	39.
Electronic Arts ... CP *(reqs. graphics brd.)*	
⊡One-on-One/Bird vs Jordan	29.
⊡Chuck Yeager's Flight Trainer	29.
⊡Chessmaster 2100	35.
⊡Earl Weaver Baseball	29.
⊡Heroes of the Lance	29.
⊡Empire	35.
⊡Mavis Beacon Teaches Typing	35.
⊡Sentinel Worlds	39
⊡Bard's Tale II	39.
⊡Grand Slam Bridge	45.
Infocom ... NCP	
⊡Zork Trilogy	33.
Microprose ... CP	
☐F-19 Stealth Fighter *(requires CGA or EGA)*	39.
☐F-15 Strike Eagle *(requires CGA)*	22.
☐Gunship *(requires CGA or EGA)*	32.
Microsoft ... NCP	
☐Flight Simulator 3.0 *(reqs. graphics brd.)*	35.
Mindscape ... CP	
☐Colony 1.0	special
🅁Balance of Power 1990	30.
☐Balance of Power	33.

PC Connection Hardware Special

through February 28, 1989

Kraft Systems ... 5 years
Premium 3-button Joystick and
Kraft High Speed Joystick Adapter Card
With Mindscape ... CP
☐**Colony 1.0**

The recreational starter kit that's just right for your PC.

- Kraft Premium 3-Button Joystick with self-centering or float operation; has an extra fire button on the top of the stick for ease of use
- Kraft High Speed Adapter Card with six position switch allowing you to match the clock speed of your machine up to 16 MHz
- Mindscape's Colony - a spectacular 3-D animated Sci-fi adventure where you are a regional marshall battling hostile aliens

Kraft Premium 3-Button Joystick	$33.
Kraft High Speed Adapter Card	25.
Mindscape's Colony 1.0	30.
Buy all three for just	79.
Or, buy just the joystick and Colony for	59.

One Step Software ... NCP	
⊡Golf Doctor 1.1 *(improve your game)*	$33.
☐Golf's Best Pinehurst #2 4.0 *(play the best)*	12.
⊡Golf Statkeeper 1.0 *(includes USGA Handicapper)*	27.
☐19th Hole Special *(3 Golf programs above bundled with Mr. Boston Micro Bartender's Guide)*	79.
☐Mr. Boston Official Micro Bartender's Guide	18.
☐Micro Video Companion 1.0	24.
☐Take Control of Cholesterol 2.0	24.
Parlor Software ... CP	
☐Bridge Parlor 2.3	49.
Sierra On-Line ... CP *(All require Hercules, CGA or EGA)*	
⊡Leisure Suit Larry	25.
⊡Leisure Suit Larry II	33.
⊡Space Quest II	33.
⊡King's Quest IV *(512k version)*	33.
⊡Manhunter	33.
⊡Police Quest	33.
⊡Police Quest II	33.
⊡3D Helicopter	33.
Simon & Schuster	
⊡Star Trek: Rebel Universe	29.
Sphere, Inc. ... NCP	
🅁Orbiter *(shuttle simulation)*	27.
🅁GATO *(submarine simulation)*	12.
⊡Tetris *(addicting mind teaser)*	24.
⊡Falcon *(F-16 simulation, reqs. graphics brd.)*	32.
Spinnaker ... CP	
☐Sargon III *(chess game)*	15.
☐Kids on Keys *(ages 3 to 9)*	19.
☐Facemaker Gold *(ages 3 to 8)*	25.
☐Kindercomp Gold *(ages 3 to 8)*	25.
☐Kidwriter Gold *(ages 6 to 10)*	32.
☐Homework Helper—Math *(grades 7-12)*	32.
☐Homework Helper—Writing *(grades 7-12)*	32.
Stone & Assoc. ... NCP *(reqs. graph. brd.)*	
⊡Algebra Plus *(ages 13 to adult)*	27.
🅁Memory Master *(ages 2 to 6)*	27.
⊡My Letters,Numbers,Words *(2 to 6)*	25.
⊡Second Math *(ages 7 to 16)*	27.
Sublogic ... NCP	
☐Jet 2.1 *(requires EGA or CGA)*	33.
☐Scenery Disks *each*	15.
☐San Francisco Star Scenery Disk	18.
☐Japan Scenery Disk	15.
☐Up Periscope	19.
The Learning Company ... CP	
🅁Math Rabbit *(ages 4 to 7)*	26.
🅁Reader Rabbit *(ages 4 to 7)*	26.
🅁Writer Rabbit *(ages 6 to 12)*	26.
True BASIC, Inc. ... NCP	
🅁Kemeny/Kurtz Math Series	32.
XOR ... NCP	
☐NFL Challenge 2.0	69.

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For computing that's faster

Or help with disaster,
You'd be hard pressed to find
A source that was vaster.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years

I/O Mini 2 C/S/P	$89.
SixPakPlus 64k C/S/P *(upgrades to 576k)*	129.
Advantage Premium 512k S/P*(upgrades to 1 Meg or 2 Meg w/Piggyback)*	call
Advantage 2-386 *(for PS/2 Model 80)*	call
RAMpage Plus 286 512k *(for XT286/AT)*	549.
RAMpage Plus MicroChannel 512k *(for PS/2 Models 50/60)*	549.

Amdek ... 90 days

LaserDrive-1 *(external CD-ROM Drive)*	629.
LaserDrive-2 *(internal CD-ROM Drive)*	629.

Compucable ... 2 years

2-Position switch box	29.
3-Position switch box	39.

Cuesta ... 1 year

Datasaver 400 Watt *(standby power backup unit for the AT)*	459.

Curtis ... lifetime

ACCESSORIES	
Curtis Clip CC-1	6.
Disk Holder DB-1 *(holds 50 5¼" disks)*	8.
3½" Disk Holder DB-2 *(holds up 40 disks)*	8.
Printer Stand PS-1	18.
Universal System Stand SS-3	25.
Toolkit TK-1	25.
CABLES	
Smartmodem-to-PC Cable EC-7 *(9 feet)*	17.
Printer-to-IBM cable EC-6 *(9 feet)*	17.
SURGE SUPPRESSORS	
Safestrip SP-3 *(6 outlets; 1 year warranty)*	19.
Filtered SafeStrip SPF-3	21.
Diamond SP-1 *(6 outlets)*	29
Emerald SP-2	36.
Ruby SPF-2 *(6 outlets; EMI/RFI filtered; 6 ft cord)*	55.
Ruby-Plus SPF-2 Plus *(w/FAX & modem protection)*	69.

DCA ... 1 year

Irma 2 Micro Channel *(for PS/2 Models 50/60/70/80)*	729.
Irma 2 *(3270 emulation board)*	729.

Epson ... 1 year

We are an authorized Epson Service Center.

FX-850 *(80 col., 264 cps, 9 pin)*	call
FX-1050 *(136 col., 264 cps, 9 pin)*	call
LQ-500 *(80 col., 180 cps, 24 pin)*	call
LQ-850 printer *(80 col., 264 cps, 24 pin)*	call
LQ-1050 printer *(136 col., 264 cps, 24 pin)*	call
LQ-2550 printer *(136 col., 400 cps, 24 pin)*	call
LX-800 printer *(80 col., 180 cps, 9 pin)*	call
Printer-to-IBM cable (6 feet)	15.

Everex ... 1 year

1200 Baud Internal Modem	79.
2400 Baud Internal Modem	149.

5th Generation ... 1 year

Logical Connection 256k	479.
Logical Connection 512k	529.

Hayes ... 2 years

Personal Modem 1200 *(with Smartcom EZ; 1 yr. wrty thru PC Connection)*	145.
Smartmodem 1200	299.
Smartmodem 1200B *(with Smartcom II)*	299.
Smartmodem 1200B *(hardware only)*	265.
Smartmodem 2400	449.
Smartmodem 2400B *(with Smartcom II)*	449.
Smartmodem 2400B *(hardware only)*	419.

Hercules ... 2 years

Graphics Card Plus	189.
Network Card Plus *(with TOPS DOS)*	339.

Intel ... 5 years

2400B Modem *(internal modem for IBM-PC/XT/AT)*	$249.
2400B Modem 2 *(internal modem for PS/2 Models 50/60/80)*	269.
Inboard 386/PC w/1 Meg	729.
Inboard 386/PC Piggyback Card w/4 Meg	1699.
Inboard 386/AT 0k *(req. installation kit)*	899.
Inboard Installation Kit *(specify computer)*	139.
Above Board Plus 512k	special
Above Board 2 Plus 512k	special
Above Board Plus I/O 512k	special
Connection Coprocessor *(FAX board plus)*	769.
Optional 2400 Baud Modem for Connection Coprocessor	229.
MATH COPROCESSORS	
8087 *(for IBM-PC & XT)*	95.
8087-2 *(8 MHz, for PS/2 Models 25 & 30)*	139.
80287 *(for AT & XT286)*	149.
80287-8 *(for 8 MHz 80286 machines)*	219.
80287-10 *(for PS/2 Models 50 & 60)*	259.
80387 *(for 16 MHz PS/2 Model 80)*	399.
80387-20 *(for 20 MHz PS/2 Model 80)*	459.

Kensington Microware ... 1 year

Masterpiece	94.
Masterpiece Plus	109.

Key tronic ... 3 years

101 Keyboard	99.
101 Plus Keyboard *(enhanced layout)*	99.

Kraft ... 5 years

Three-button Joystick	special
High Speed Joystick Adapter Card	special
Adapter Card/3-Button Joystick Bundle	49.

KYE International ... lifetime

Dyna Mouse GM6+ *(w/Dr. Halo III)*	54.

Logitech ... lifetime

Series 2 Mouse *(for PS/2 50/60/70/80)*	65.
HiREZ Mouse *(bus only)*	89.
Mouse w/Paint Show *(bus or serial)*	95.
Mouse w/LogiCAD *(bus or serial)*	119.
ClearCase Mouse *(serial only)*	99.
ScanMan *(hand held scanner)*	199.

Magnavox ... 2 years

14" VGA Monitor *(9CMO62)*	389.
14" VGA Monitor *(9CMO82)*	449.
VGA Adapter *(9AV600)*	249.
14" Hi-Res EGA Monitor *(9CMO53)*	369.

Microsoft ... 2 Years

Mach 20 *(1 yr. wrty.)*	349.
Disk+Option *(for Mach 20; 1 yr. wrty.)*	69.
Memory+Option *(for Mach 20; 1 yr. wrty.)*	339.
Mouse with Paintbrush *(bus or serial)*	special
Mouse with Easy CAD *(bus or serial)*	special
Mouse with Windows/286 *(bus or serial)*	special

PC Connection Hardware Special

through February 28, 1989

Microsoft ... lifetime
The New Microsoft Mouse

Microsoft has built a better mouse with an all new look and feel. With over one million Microsoft mice now in use, it is easy to see the popularity of performance. Choose among one of the following three software bundles with either a Bus or Serial/PS2 interface:

- EasyCAD, a two-dimensional computer-aided design program
- Microsoft Paintbrush and Mouse Menus
- Microsoft Windows 286 and Microsoft Paintbrush for Windows

(specify Bus *or* Serial/PS2 interface)

Mouse with EasyCAD	$121.
Mouse with Microsoft Paintbrush and Menus	105.
Mouse with Windows 286 and Microsoft Paintbrush for Windows	139.

1-800/243-8088

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So bring on the snow!

And let those winds blow!
Your hottest Connection's
Still PC in Marlow.

MSC Technologies ... lifetime	
OmniMouse *(serial only; 1 year warranty)*	$57.
PC Mouse II w/PC Paint + *(bus or serial)*	89.
PC Mouse II w/Autosketch *(bus or serial)*	105.
NEC ... 2 years	
Multisync II *(800 x 560 max. resolution)*	599.
NSi Logic ... 3 years	
Smart VGA *(supports full VGA specs)*	239.
Orchid Technologies ... 2 years	
Tiny Turbo 286 *(accelerator board)*	289.
ProDesigner VGA *(800x600 VGA Mode)*	319.
RAMquest Xtra 16/32 0k	339.
PC Power & Cooling Systems ... 1 year	
REPLACEMENT POWER SUPPLIES	
Turbo Cool 150 *(run 25° - 40° cooler)*	129.
Turbo Cool 250 *(run 25° - 30° cooler)*	169
Silencer 150 *(84% noise reduction)*	115.
Silencer 200 *(69% noise reduction)*	149
Turbo Cool 375	299
PC Support Group ... 1 year	
Breakthrough 286 Accel. Board *(8 MHz)*	299
Breakthrough 286 Accel. Board *(12 MHz)*	449.
Practical Peripherals ... 5 years	
1200 Baud Internal Modem *(w/ProComm)*	69.
1200 Baud External Modem *(mini)*	79.
Microbuffer Inline *(per print buffer/32k)*	135.
2400 Baud Internal Modem	159
2400 Baud External Modem	189.
Princeton Graphics ... 1 year	
Ultrasync *(supports CGA, EGA, VGA)*	549
Max15 Monochrome Monitor	269.
Safe Power Systems ... 2 years	
Safe 250W *(standby power backup)*	249.
Safe 425W *(standby power backup)*	369
Toshiba ... 1 year	
P321SL printer *(80 col., 216 cps, w/tractor)*	529
T1000 Laptop *(80C88, 6.4 lbs., 5 hr. battery)*	call
T1200 Laptop *(80C86, 10 MHz, 20 Meg)*	call
T1200HB Laptop w/Backlit screen	call
T1200FB Laptop Dual Floppy System w/Backlit screen	call
T3200 Laptop *(80286, 12 MHz, 40 Meg)*	call
T5100 *(80386, 16 MHz, 40 Meg)*	call
768k RAM Card for T1000	299.
Video 7 ... 5 years	
VEGA Deluxe *(supports 640x480)*	219.
VEGA VGA *(supports full VGA specs)*	287.
FastWrite VGA	379.
VRAM VGA	529.

DRIVES

Alloy ... 1 year	
Tape System/2 *(for PS/2 MicroChannel)*	299
Retriever/40 *(for IBM AT & compatibles)*	349.
IOMEGA ... 1 year	
Dual 20 Meg Bernoulli Box *(8")*	1679.
20 Meg Cartrige *(8")*	$82.
20 Meg Tripak *(8")*	244.
Bernoulli II Single 20 Meg Internal *(5¼")*	767.
Bernoulli II Dual 20 Meg External *(5¼")*	1659.
20 Meg cartridge *(5¼")*	59.
20 Meg Tripak *(5¼")*	169.
PC2 Card	169.
PC2B Card *(bootable card for PC/XT/AT)*	229.
PC4 Card *(for PS/2 Model 50/60/70/80)*	299.
Mountain Computer ... 1 year	
40 Meg Internal Tape Drive *(XT, AT or PS/2)*	379.
40 Meg External Tape Drive *(XT, AT or PS/2)*	479.
40 Meg External Tape Drive w/Power Supply *(XT, AT, or PS/2)*	569.
Plus Development ... 2 years	
Hardcard 20 Meg *(49 ms)*	549.
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Color Digital Imager IV

The Color Digital Imager IV (CDI-IV), at $3,995, is a large, rectangular desktop unit. The camera, a Minolta XG-1, fits easily into an inset front shelf and is protected by a dark plastic cover. The CDI-IV is simple to assemble, thanks in large part to an excellent, well-illustrated manual. Technology-shy users will find that the absence of either a video board (the CDI-IV requires a standard serial port) or controller software makes installation easier, although the unit does come with an optional screen capture and text-processing utility.

The CDI-IV also features a small, separate module that holds up to four font cartridges simultaneously. Although the CDI-IV sports only one hardware font, a Sigma light face, there are a total of 17 available. A three-font pack option that includes a Helvetica and two Times Roman faces costs $450.

Many functions that other film recorders control through software are hardwired into the CDI-IV. A series of buttons located conveniently on the front of the machine lets you turn on the power and reset the recorder. An Expose button lets you take manual shots, and a thumb-wheel switch allows you to make up to seven copies of a slide. LED indicators, also located on the front panel, tell you when the power is on and when an error occurs. A second thumb-wheel switch inside the cover determines film type.

The back of the recorder contains the serial port, another thumb-wheel toggle that sets serial port parameters, a switch that activates the diagnostic routine, and a port for an optional hi-res monitor. The hi-res monitor lets you view the image that the machine is recording and allows you to use the CDI-IV's internal diagnostics system (more intensive than the switch-activated diagnostics routine mentioned previously), which tests such features as patterns, color levels, RAM, and font extensions. I found the internal diagnostics system useful—it detected a loose font cartridge on the first go-around, and on the second told me which slot was occupied, and by what font.

PC MAGAZINE FACT FILE

Color Digital Imager IV (CDI-IV)
Bell & Howell Quintar Co.
411 Amapola Ave.
Torrance, CA 90501
(800) 223-5231
(213) 320-5700 (in Calif.)

List Price: $3,995 with 35mm camera, Polaroid pack film back for Type 669 instant color print film, Polaroid automatic processor system, font extension module, and one font cartridge.

Requires: serial communication port (RS-232).

In Short: The CDI-IV is a midrange film recorder that doesn't yield the sharpness of detail that you get from its more expensive peers, but does give good color quality and the option to substitute a variety of hardware fonts.

CIRCLE **670** ON READER SERVICE CARD

The Color Digital Imager IV is hardwired through its front-panel buttons to control many functions that other film recorders manage through software. The CDI-IV also relies on hardware (in the form of font cartridges) to produce its best text images.

Photographs: Thom O'Connor

The CDI-IV can take advantage of all 16 million colors available on most PCs, but how many of those colors it actually uses depends upon how many passes each filter makes as a graphic is processed. The simplest, and fastest, configuration will cause the machine to make one pass with each of its three filters, giving users access to the basic 16 colors. This is quite adequate for simple text and graphics images; it had no problem reproducing PC Labs' TEXT1 test file. (See our benchmark-test results for descriptions of the test files we used to evaluate the film recorders in these reviews.) However, more-sophisticated graphics will experience severe color distortions, especially if they include difficult effects such as color gradation. Our GRAPH2 test file was reproduced with the right images in the wrong colors.

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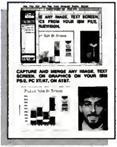

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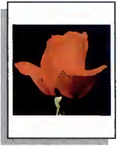
These images were captured with *Pizazz Plus*, imported into Ventura Publisher and printed.

IBM PS/2 VGA and MCGA



Pizazz Plus printed image from an IBM PS/2 VGA.

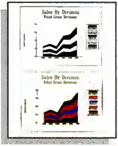
- Deepen blues, enrich reds, and sharpen greens with on screen VGA 256,000 level color adjustment. Color images are automatically converted to gray scales on screen.
- Go from 4 color printing to full color printing with expanded printer capability.
- Automatically convert text screens to graphics.
- No more printer limitations—what you see on screen is what you'll get on paper.

Professional Printing

- For a print out that doesn't look like it was created with a computer, make circles round and flowers soft with the smoothing feature.
- Choose your own standard of measurement, whether it's inches, millimeters, or points.
- Don't loose the detail when sizing your image up or down—*Pizazz Plus* preserves proper aspect ratio.
- Select your print size and position on paper to .01".

Pizazz Plus printed image from an AT&T Truevision TARGA 16.

Resolves Incompatibility



Pizazz Plus printed images from an IBM EGA.

- Connect with over 200 printers—that's twice as many as most applications support.
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- Works with virtually all PC DOS applications.

Pizazz Plus Compatible Hardware

IBM PS/2: Models 25 and 30 (MCGA), and Models 50, 60, and 80 (VGA)
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VGA Compatible Adapter Cards: *(ONLY Supported in IBM PS/2 VGA Compatible Modes)* AST VGA, Compaq VGA, Orchid Designer VGA, Paradise VGA Plus Card, Video-7 VEGA VGA
AT&T 6300 Display Adapter Cards: Image Capture Board (ICB), Truevision TARGA 16, DEB
PRINTERS: Adobe Systems PostScript, **Alps** ALQ200 (18 and 24 pin), ALQ300 (18 and 24 pin), P2400C (18 and 24 pin), **AMT** Office Printer, **Anadex** 9625B, 9725, S7024, S7024C, **AST** TurboLaser/PS, **AT&T** 477, **C. Itoh** 1550 Prowriter, 8510, 8510BPI, 8510SC, C-310 CXP, C-315 CXP, C-715A (LQ-1000), **CalComp** ColorMaster, ColorView 5912, PlotMaster, **Canon** A1210, PJ-1080A, **Centronics** 250, 260, 358, 359, **CIE** LIPS 10, **Citizen** MSP-20, MSP-25, **Dataproducts** 8000, 8001, 8002, 8010, 8011, 8012, 8020, 8021, 8022, 8050, 8051, 8052, 8070, 8070 Plus (IBM), 8070 Plus (P-Series), 8071, 8072, M-480, P-80, P-132, **Diablo** C150, **Epson** DFX-5000, EX-800, EX-1000, FX-80, FX-85, FX-86e, FX-100, FX-185, FX-286, FX-286e, FX-850, FX-1050, GQ-3500, GQ-3500 (1.5Mb), HS-80, JX-80, LQ-800, LQ-850, LQ-950, LQ-1000, LQ-1050, LQ-1500, LQ-2500, LQ-2550, LX-80, LX-90, LX-800, MX-80 w/Graftrax, MX-100 w/Graftrax, RX-80, RX-100, SQ-2000, **Fujitsu** DL2400, DL2600, DL3300, DL3400, DotMax 24C, DPL24C, DX2100, DX2200, **Genicom** 1000 (Epson), 1000 (IBM), 3310, **Hewlett Packard** LaserJet, LaserJet+, LaserJet Series II, PaintJet, ThinkJet (Epson MX-80 Mode), **IBM** Color Jetprinter, Graphics Printer, PC Color Dot Matrix, ProPrinter, ProPrinter XL, Quietwriter 5201-002, **IDS** Microprism, Prism 80, Prism 132, **Infoscribe** 1200, **JDL** 850, **NEC** CP6, CP7, LC-800, P2200, P5, P5XL, P5200, P5300, P6, P7, P9XL, **Newbury Data** OSP-2, OSP-3, **Oasys** LaserPro 810-R, **Okidata** Laserline 6, Microline 82, 83, 84, 92, 93, Microline (Plug&Play) 82, 83, 84, 92, 93 Microline (IBM) 182, 192, 193, Microline 292, 293, 294, 320, 321, Microline (IBM) 292, 293, 294, 320, 321, 390, 391, 393, Okimate-20, **Panasonic** KXP-1080i, KXP-1091, KXP-1091i, KXP-1092, KXP-1092i, KXP-1093, KXP-1524, KXP-1592, **Printronix** S7024, S7024C, **QMS** PS 800, PS 800 Plus, PS 800 II, **Quadram** Quadjet, QuadLaser, **Qume** LaserTEN Plus, **Seikosha** SPC-700, **Star Micronics** Delta-10/15, Gemini-10X/15X, NX-10 (IBM), Radix-10/15, SD-10/15 (IBM), SG-10/15 (IBM), SR-10/15 (IBM), **Tandy** (Radio Shack) CGP-220, **Tektronix** 4693D, 4695, 4696, **Toshiba** P321, P321SL, P351, P351C, P351SX, P1340, P1351, **Transtar** 315, **Xerox** 4020.

Supports Microsoft Windows V1.xx and V2.xx. Images courtesy of AT&T and Spinnaker Software. Pizazz Plus is not copy protected. Memory resident program takes as little as 32K.

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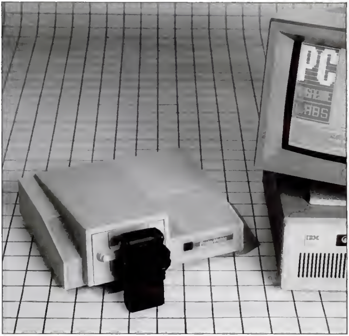
the machine do three redraws of the graphic, separating each image into its red, green, and blue components. The increased density gives you access to 4,096 different colors; it also slows down the machine considerably, by the same factor of three. For example, while CDI-IV took only 25 minutes to reproduce GRAPH2 with one pass, it took an hour and 14 minutes using all 4,096 colors. The simple TEXT1 file's time was also nearly tripled, from 1 minute 34 seconds to 3 minutes 24 seconds. This is where the hi-res "preview" monitor comes in handy: users producing any but the most basic graphics with the faster mode are advised to watch for color distortions that would make the more time-consuming process necessary.

The CDI-IV's final output was, for the most part, acceptable. But users should not expect the quality of output that they would get with more expensive recorders: even with the three passes, background color gradations were much less subtle than in higher-end machines we looked at in the following reviews. The recorder also had a problem with text, which was detectably jagged along the edges. This situation was vastly improved when I substituted CDI-IV's hardware font—it not only produced a much smoother, professional finish but also took a full minute off the timing of the TEXT1 file.

Certainly, the CDI-IV doesn't meet the standards of its more expensive peers. Users should be prepared for a substantial wait on complex graphics, and they should use the hardware font cartridges to produce their text slides. But considering the number of colors you can access and the general quality of graphics images, the CDI-IV is a good buy at less than half the price of a Lasergraphics or Matrix film recorder.
—Barbara Krasnoff



The $6,190 PhotoMetric SlideMaker works symbiotically with a companion product also from General Parametrics: the $4,595 VideoShow. Both benefit from widespread graphics software support and from display technology that includes a hi-res preview option.

GENERAL PARAMETRICS CORP.

PhotoMetric SlideMaker

General Parametrics is probably best known for VideoShow, a self-contained piece of hardware that you can plug into a monitor to display a sequence of graphics images on screen as a desktop "slide show." The company's PhotoMetric SlideMaker is a 4K-resolution film recorder with a midrange price of $6,190, including the required expansion board. As one might expect, it's designed to be fully compatible with VideoShow, which is both its greatest strength and its greatest weakness.

The strength lies primarily in the huge quantity of graphics software that supports VideoShow and therefore the PhotoMetric SlideMaker. The current count of compatible packages stands at something over 40, according to General Parametrics. Another immediate advantage to anyone already owning a VideoShow unit: you can connect the SlideMaker directly to it and turn your VideoShow images into slides without the use of a computer.

The SlideMaker also benefits from the VideoShow display technology built into the ColorMetric 20 Card, which runs the SlideMaker. This lets you preview your graphics files on-screen at a resolution of 2,000 by 500 even with a CGA monitor, though with a noticeable flicker. This gives you a more accurate representation than EGA resolution of how your pictures will look as high-resolution slides or photos. The board can also display up to 1,000 simultaneous colors if your picture files were created with a graphics package capable of using this palette. (One package with this capability is General Parametrics' own *PictureIt*, which unfortunately is quite limited in its other capabilities.)

The PhotoMetric SlideMaker relies a little too heavily on General Parametrics' flagship product, however. Unless you have a VideoShow hooked up to your computer, there's no way you can send graphics files directly from a graphics package to the film recorder. And the VideoShow's $4,595 price tag makes it a

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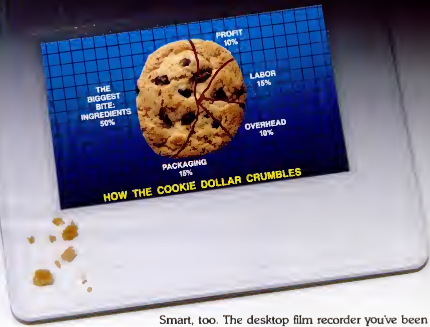

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Performance Tests: Digital Film Recorders

These performance tests measure the time a film recorder takes to process and shoot four images of differing complexity. The images are intended to represent the full spectrum of business presentation slides, from simple text to very complex graphics.

Brilliant Images of New York designed and produced the slide images, providing us with both image data and

Testing Procedures

Each film recorder was connected to an IBM AT model 339 with a 30MB hard disk drive, a serial and a parallel port, and a single 1.2MB high-density floppy disk drive. We used the Vega Video Seven EGA adapter card as the video interface to a NEC MultiSync monitor. While some of the film recorders used the standard IBM serial or parallel port to communicate with the PC, others required installation of their own proprietary interface boards.

Performance results will vary with the speed of a given film, and film type is critical for exposure time, resolution, color output, and general slide quality. We chose to use Kodak Ektachroma 100, as recommended by most film recorder manufacturers.

The processing and shooting times for each film recorder were measured in seconds from the moment the imaging command was issued to *Mirage* until the photograph was taken—not until control of the keyboard returned, since some of the film recorders buffer the information, returning keyboard control before the picture is complete. The test results reflect how long *Mirage* had to work to process the file and transfer it to the film recorder plus the time the film recorder required to take the picture.

The results, measured in whole seconds, have not been compared with a specific film recorder because there is no standard within the film recorder industry. While all slides were shot with the same film under similar conditions, resolution is a factor that seriously affects output speed. We tested each film recorder at 2K since most people work in this resolution (a good compromise between optimal quality and maximal speed). Shooting at 4K will take longer.

The Polaroid PalettaPlus boasts the best times with all four slides primarily because of its limited output resolution–a maximum of 640 dpi (dots per inch) horizontally. The image is photographed much faster than with any other film recorder but at a loss of resolution and quality.

Bell & Howell's Color Digital Imager IV was second-fastest in producing the TEXT1 and GRAPH1 images yet did not do as well with the complex images.

The PhotoMetric SlideMaker and the Lasergraphics Film Recorder are not directly supported by *Mirage*. However, *Mirage* does allow you to send an output file through a specified port to the film recorder. For these two recorders, the performance times were measured from the moment the command was entered until the photograph was taken.

The PhotoMetric SlideMaker, whose images were shot in 4K, came in third in producing TEXT1 and GRAPH1 slides. But it was the slowest with the TEXT2 image. The Lasergraphics Film Recorder finished in the middle of the pack for TEXT1, TEXT2, and GRAPH1 but had difficulty with GRAPH2; it was the second slowest in producing this slide.

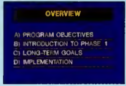
The Montage FR1 performed consistently on the low end of the spectrum, with last-place showings for both GRAPH1 and GRAPH2 slides and second-to-last place for the other two images.

At 2K resolution the Matrix PCR produced TEXT2 and GRAPH2 slides faster than the competition and managed a midrange performance with TEXT1 and GRAPH1. Its sibling recorder, the Matrix ProColor, was the slowest to produce TEXT1, and second to the last with GRAPH1. But it managed to come in third with both of the more complex images.

The Performance Test Images

The four test files we used were TEXT1, a simple text image; TEXT2, a complex text image; GRAPH1, a simple graphics image; and GRAPH2, a complex graphics image. The files were in the .IMA format that *Mirage* uses.

TEXT1 test slide
(file size = 6,142K)



OVERVIEW

A) PROGRAM OBJECTIVES
B) INTRODUCTION TO PHASE 1
C) LONG-TERM GOALS
D) IMPLEMENTATION

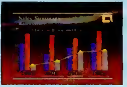
TEXT1 is a text file with no exceptional character fonts or shadings and a simple color palette.

TEXT2 test slide
(file size = 13,850K)

Any Image Worth Presenting Should Be
BRILLIANT

The TEXT2 file is composed of a more complex text image on a gradated gray background with a light blue grid of horizontal lines. Gray is one of the more difficult hues of the entire color palette for a film recorder to reproduce and thus is a true test of a film recorder's color capabilities.

GRAPH1 test slide
(file size = 16,792K)



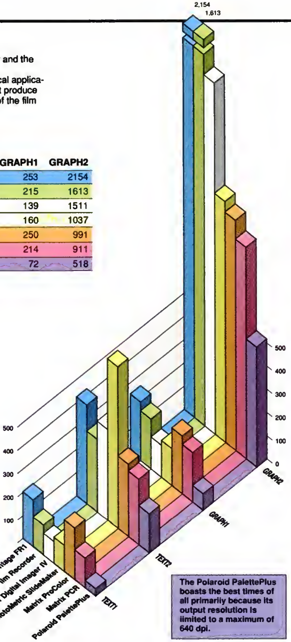
The GRAPH1 image, representing a conventional business graph, is a multicolored bar chart with white numbers and letters for legends. The maroon background is shaded from dark to light. Maroon, like gray, is one of the more difficult colors for a film recorder to reproduce, especially when the color is gradated.

professional-quality slides. It used a QCR film recorder and the *Mirage* graphics program.

We chose *Mirage*, from Zenographics, as the graphical application interface for two practical reasons. Not only does it produce excellent graphics, it provides device drivers for most of the film recorders we tested.

Performance Times
(Times given in seconds)

	TEXT1	TEXT2	GRAPH1	GRAPH2
Montage FR1	204	426	253	2154
Lasergraphics Film Recorder	130	315	215	1613
Color Digital Imager IV	94	393	139	1511
PhotoMetric SlideMaker	113	698	160	1037
Matrix ProColor	224	314	250	991
Matrix PCR	129	285	214	911
Polaroid PalettePlus	33	171	72	518



The Polaroid PalettePlus boasts the best times of all primarily because its output resolution is limited to a maximum of 640 dpi.

GRAPH2 test slide
(file size = 86,966K)

GRAPH2 is a complex assortment of images overlaid on each other, using more colors than the other image files, to take full advantage of the film recorder's color and resolution capabilities.

Performance Tests: Digital Film Recorders

Truth in Imaging

Distortion in an image is sometimes hard to pinpoint. The eye moves around to take in information—especially if the image is complex—and you may sense that something is wrong without knowing the precise cause. To limit the subjectivity inherent in evaluating distortion, PC Labs developed a rigorous test procedure.

The Distortion Test Image

To evaluate distortion in the slides produced by the seven film recorders reviewed here, we created a very simple image: a series of concentric rectangles with a cross in the middle splitting the slide in half horizontally and vertically. The rectangles were drawn in different colors for visibility and matched the aspect ratio of a slide. The background was a sweep from white to black to make the recorder work harder. The more work required of a film recorder, the more likely it is to distort the image.

Straight lines are the severest test of distortion because they clearly show any tendency to curve an image or stretch it out of square alignment. They also make it easy to measure the degree of distortion.

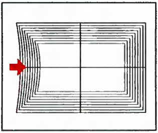
We used 35mm ASA/ISO 100 Ektachrome film, and the slides were processed and mounted at the same color lab. A Nikon Measure Scope connected to a Boeckeler Digital Microde X/Y Coordinate Interpreter (Model 1-815-1) was used to take measurements of the outermost rectangle and the cross in our test image. (The Nikon scope and the Boeckeler interpreter are accurate to one thousandth of an inch.)

Types of Distortion

The measurements we obtained were run through over a dozen empirical formulas to compute four types of distortion, involving linearity, pin cushioning, trapezoidality, and orthogonality.

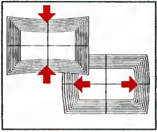
All the film recorders had strikingly low distortion percentages, and the variance in results from one recorder to the next were within a very narrow range—too narrow, in fact, to make the results worth publishing. Our testing revealed virtually no distortion in the output of the seven film recorders under review.

Linear distortion



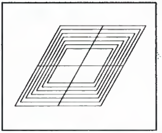
A deviation in linearity results in a bent line.

Pin cushioning



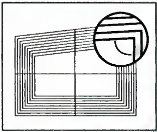
A pin-cushion error bows the rectangle into a slightly convex or concave shape on the vertical or horizontal plane or both.

Trapezoidal distortion



Trapezoidality shows vertical and/or horizontal divergence from a true rectangle into a skewed four-sided shape.

Orthogonal distortion



Distortion in orthogonality causes the 90-degree angle of a rectangle's corner to become acute or obtuse.

FACT FILE

PhotoMetric SlideMaker
General Parametrics Corp
1250 Ninth St.
Berkeley, CA 94710
(800) 556-1234 x234
(800) 441-2345 x234 (in Calif.)

List Price: $6,190 with ColorMetric 20 Graphics Card; VideoShow, $4,595.

Requires: 384K RAM (640K recommended for optimal performance), two disk drives, graphics card and monitor (CGA, EGA), one expansion slot, DOS 2.1 or later.

In Short: The PhotoMetric SlideMaker is notable for its widespread software support and for letting you preview your slides on a CGA or EGA monitor at 2K resolution with 1,000 simultaneous colors. Unfortunately the film recorder is difficult to use, poorly documented, and doesn't let you send files directly from a graphics package to the recorder. Software not copy protected.

CIRCLE **669** ON READER SERVICE CARD

rather expensive add-on.

Without VideoShow, producing photographs from files created by a graphics package is a slow and annoying process. From within your graphics package you must convert the files to PhotoMetric format and write them to disk. You then load the PhotoMetric program to call up the files and send them to the film recorder. It's important to note that when you convert a file, it more than doubles in size. For example, our complex graphic test file, GRAPH2, is 86K in its native form. Once converted to PhotoMetric format, it grows to 220K.

Rather than letting you summon any file with the correct extension, as most film recorders do, the PhotoMetric program doesn't recognize files whose names aren't included in a table of contents file. If the graphics package you use to convert your files to PhotoMetric format doesn't update the table of contents file (*Mirage*, the package we used, didn't), you'll have to use a pure ASCII word processor to do it yourself—a procedure undocumented in the minimal manual that comes with the PhotoMetric SlideMaker.

A major liability of both the PhotoMetric documentation and the controller program is that they assume you will be using the VideoShow unit with the film recorder. For example, the program defaults assume you'll want to use a floppy disk for storing the pictures you wish to photograph, even if you've installed the program on a hard disk. This is because the easiest way to use VideoShow is to copy your picture files onto a floppy and insert it into the VideoShow unit's floppy disk drive. If you choose to store your pictures in a hard disk subdirectory, you must copy the table of contents file into that directory from one of the program disks and then alter a setting in the configuration menu. The inadequate documentation of these points cost us several hours of frustration in getting the software to work properly.

Once the PhotoMetric software is up and running, it offers some nice features. It gives you a menu listing of all the picture files included in the table of contents and lets you move the cursor to any file to preview it on-screen or photograph it. You can also mark any number of files to photograph as a batch job and can shoot multiple copies of files.

The PhotoMetric comes with a Pentax 35mm camera that offers automatic loading and film advance features, but only manual rewinding. The Polaroid CB103 pack film back, which exposes Type 669 instant color print film, is also offered as a $298 option.

Shooting your pictures at 4K resolution is a slow process, though we found that using one of the PhotoMetric's six built-in hardware fonts reduced the time it took to shoot our TEXT1 file by about 25 percent. The output from the SlideMaker proved rather disappointing for a film recorder offering 4K resolution. The curves and diagonal lines in text appeared surprisingly jagged. A number of often inexplicable inaccuracies also crept into the slides. The blue background of TEXT1 came out as black, while the black box around the title was rendered as brown. The recorder did reproduce the maroon and gray backgrounds of GRAPH1 and TEXT2 (two of the hardest colors to reproduce), but as several thick bands rather than as continuous gradations of color. The complex GRAPH2 came out fairly well, but some of its circles were reproduced as squares.

The PhotoMetric SlideMaker's main selling points are its widespread support among graphics packages and its high-resolution on-screen preview capability. Unfortunately, its inability to receive graphics files directly from a graphics package, its cumbersome controller software, and its poor documentation make it a real struggle to operate.—**Robert Kendall**

LASERGRAPHICS INC.

Lasergraphics Film Recorder

The Lasergraphics Film Recorder (LFR), at $9,950, is a bit larger than most of its competitors—approximately 22½ inches long, it takes up a good deal of room. But users won't begrudge the desk space to a film recorder that packs a considerable punch.

The LFR—which replaces the PFR, Lasergraphics' previous entry in the film recorder market—uses a Rascol II controller board to rasterize the image produced by the computer and send it out to the film recorder via a high-speed parallel port. The board fits into a full-sized slot and comes loaded with a full megabyte of memory, adequate to handle PC Labs test files. Lasergraphics will add another megabyte of memory for $770, but users who need it would find it easy enough to install the extra chips themselves.

The Rascol II—and, by extension, the Lasergraphics LFR—is driven by a RAM-

FACT FILE

Lasergraphics Film Recorder
Lasergraphics Inc.
17671 Cowan Ave.
Irvine, CA 92714
(714) 660-9497

List Price: $9,950 including Rascol II board, 35mm camera, software, and cables, $11,595 with Macintosh interface included. Optional add-on Macintosh interface, $1,795.

Requires: 256K RAM, hard disk recommended.

In Short: In concert with a Rascol II controller board, the LFR is a flexible, easy to operate machine that produces high quality output.

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PC MAGAZINE SLIDE SHOW: PICKS AND PANS

When film recorder companies talk about slide quality, they throw around numbers like 2K or 4K addressable resolution and 100,000 or 16.7 million colors. But numbers only hint at quality. Film recorders with the same specs may produce slides that look dramatically different, and even numerically inferior recorders may deliver good slides. The true test of quality is how the slides look in a real-life situation—projected onto a white screen in a darkened room. Of course, this puts the emphasis on the viewer and makes quality a subjective issue.

To test the seven film recorders in a realistic environment, we took the best simple-text (TEXT1), complex-text (TEXT2), simple-graphic (GRAPH1), and complex-graphic (GRAPH2) test slides produced by each film recorder and projected them onto a Da Lite Model I matte white screen with a Kodak Ektagraphic III ATS projector. The Kodak projector has a 4-inch lens and magnified the original slide images 30 times by displaying them at a distance of 20 feet. Each slide was carefully removed from its original cardboard mount, cleaned, and put in a Westmount glass mount to prevent the image from being warped.

We tried to smooth out the subjectivity of our assessment by using eight people to judge the slides. The panel consisted of a graphics designer, a professional photographer, and several editors and technical engineers. Our judges did not know which slides came from which film recorders, and the slides were in a different sequence for each test.

Slide Show: Picks and Pans

Product	TEXT1	TEXT2	GRAPH1	GRAPH2
Color Digital Imager IV	■ ■	■	■ ■	■
PhotoMetric SlideMaker	■	—	■	■ ■
Lasergraphics Film Recorder	■ ■ ■	■ ■ ■	■ ■ ■ ■	■ ■ ■
Matrix PCR	■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■
Matrix ProColor	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■
Polaroid PalettePlus	■	—	—	■ ■
Montage FR1	■ ■ ■	■ ■ ■	■ ■ ■	■ ■

■ ■ ■ ■ = Excellent
■ ■ ■ = Good
■ ■ = Fair
■ = Adequate
— = Fail

The judges were instructed to look for the general sharpness and clarity of the images and the richness of color. In particular, they were to check for jagged text edges, blurred text, color bleed at the edges of images, consistent color density and brightness, background banding, darkened corners or borders, and horizontal or vertical stretching of the images. The slides produced by Brilliant Images, a professional service bureau using the high-end QCR film recorder from Matrix, were used as a point of reference.

Each judge graded the slides on a scale of 0 to 4. The eight scores for each slide were then averaged to give the final score listed in the table. By comparing the scores for the four different slides produced by each film recorder, you can get a good idea of the recorders' real quality.

Overall, the panel judged the Matrix PCR, the Matrix ProColor, and the Lasergraphics Film Recorder the best units, each averaging 4 points on at least one test. The Montage FR1 also fared well, averaging 3 points on all but the complex graphic image. The Polaroid PalettePlus and the PhotoMetric SlideMaker were consistently perceived as having the worst output of the group. While neither could handle the complex text image, both managed to accept the complex graphic image with some dignity. Bell & Howell's Color Digital Imager IV was judged adequate on all four slides, placing it above the worst two film recorders but far below the top four.

resident program that must be loaded into memory prior to using the film recorder. Once there, it stays in the background, controlling factors such as input language, film type, color balance, plotter controls, default resolution, and calibration patterns. A separate program supplies a simple options menu through which you can alter the film recorder's defaults.

The LFR unit itself contains no hardware switches and only two LEDs: a red light for error conditions and a green one that blinks slowly while the image is being exposed. (Impatient users would be well advised to keep track of the process of this or any film recorder, since a steady glow from the LED on some machines indicates that the machine is not in use and on others that an image is being assembled.)

The system comes with a standard 35mm camera (either a Nikon N-2000, which came with the test machine, or a Pentax PT135) which slips into a triangular slot at the front of the machine and is secured with a single clip. The Nikon N-2000 is simple to load—anybody who's ever taken vacation pictures shouldn't

Bright Ideas

Distribution Network

Retail

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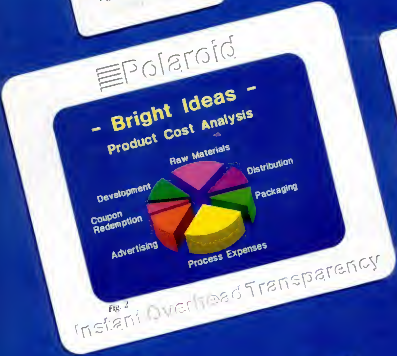
Direct Response

Fig. 1



Polaroid

- Bright Ideas -

Product Cost Analysis

Instant Overhead Transparency

Fig. 2

- Bright Ideas -

Product Overview

Look

Genius

Synergy

Time

Image

Content

Fig. 3

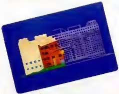


Fig. 4

Fig. 5

Fig. 6

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PalettePlus

The PalettePlus Computer Slide Maker gives you everything you need to create presentation-quality instant color prints, instant or conventional 35mm slides, or overhead transparencies off your IBM PC, AT or XT. The distribution chart (Fig. 1) was reproduced by PalettePlus on Polaroid High Contrast PolaChrome Instant 35mm Slide Film.

Turbo Palette

The new low cost Turbo Palette produces color prints, instant or conventional 35mm slides and overhead transparencies with an apparent resolution of 2000 x 1340 lines. It works with the IBM AT, XT, PS/2, or any IBM compatible computer with a serial port. The pie chart (Fig. 2) was made using Turbo Palette and Polaroid Type 691 small format overhead transparency film. The product overview (Fig. 3) was shot on new Polaroid Presentation Chrome conventional slide film.

Bravo Computer Slide Maker

The Bravo Computer Slide Maker creates super sharp color 35mm slides, with 2000, 4000, or 8000 lines of addressable resolution. It can be used with both IBM and Apple Macintosh PC's. The architectural model (Fig. 4) was made with the Bravo Computer Slide Maker using new Polaroid Presentation Chrome conventional slide film. The logo design (Fig. 5) was reproduced on High Contrast PolaChrome Instant 35mm Slide Film. And the seminar invitation (Fig. 6) has been generated on Presentation Chrome.

All of these Computer Slide Makers come with the Polaroid Good-as-Gold Guarantee—if you're not fully satisfied with your computer slide maker, you may return the system within 90 days for a full refund—no questions. Ask your dealer for details.

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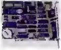

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CIRCLE 275 ON READER SERVICE CARD

The Lasergraphics Film Recorder test unit came with an easy-to-load Nikon camera—anybody who's ever taken vacation pictures should have no trouble using it. The recorder is also smart enough to alert users when film has run out during batched film exposures.

have any trouble—and it advances automatically. And you needn't worry about running out of film at a crucial point during batched file exposures: if this occurs, the two LCDs will flash until you remove the film and reload the camera, at which point the LFR will automatically continue.

One of the LFR's major assets is its flexibility. The machine can accommodate a number of different hardware and software needs. For example, it works with several file languages, including the default Lasergraphics Language, Hewlett-Packard Graphics Language (HPGL), Graphic Software Systems Computer Graphics Interface, VideoShow, and Targa image files. The LFR can be configured to an addressable resolution of either 4K or 2K. With an optional interface, the LFR will support a Macintosh and a PC simultaneously.

The Lasergraphics system also offers a wide range of choices pertaining to output quality. Users can not only choose between the 2K and 4K resolutions but can also specify one of two separate settings for Ektachrome ASA/ISO 100 film: "fast," which uses 2 million colors, is included so that users can save time on less important images; and "fine," which makes available the full range of 16 million colors.

The fine and fast mode settings have limited use. In the PC Labs tests, it took 1 minute 30 seconds to produce the simplest text chart, TEXT1, in fast mode; in fine mode, it slowed to 2 minutes 10 seconds. However, I found that as the complexity of the image increased, the difference between the two speeds decreased—the complex GRAPH2 file took 26 minutes 49 seconds in fast mode and only 4 seconds more in fine mode. In addition there was, to my eye, no discernible qualitative difference between the two.

Once set in motion, the LFR goes about its business efficiently and quickly, with little fuss or bother. It handled the files produced by *Mirage* without a murmur, and the output was quite satisfactory. Colors reproduced well, although they seemed a bit muddy when compared with those of more expensive film recorders. Background gradations were soft and evenly shaded, although banding was a bit more visible than in more expensive machines. I had absolutely no complaints with the text: the lettering was precise and well-defined, with sharp edges and smooth curves.

In May 1988, Lasergraphics touted its new LFR as the first to offer fast, boardroom-quality output for under $10,000. Only a few months later it already had some rivals on the horizon. Nonetheless, this powerful and flexible machine is definitely still in the running.

—Barbara Krasnoff

MATRIX INSTRUMENTS INC.

Matrix PCR

The Matrix PCR is the most expensive of the lower-priced film recorders. It costs $13,790 or $14,290, depending on whether you choose the MVP-PC or MVP-Star add-in board. Although these prices are several thousand dollars more than the PCR's closest competitor, the numbers shouldn't scare you. For the PCR's relatively lofty price, you get superior resolution and color in your slides—clearly the best of the film recorders reviewed here.

The PCR is the only film recorder in the group that doesn't perch on your desk. It stands 3 feet tall, on wheels, and has a slightly angled control panel at the top, rising vertically above its rectangular body. But it takes up only a 1½ square feet of

For the Matrix PCR's lofty price (about $14,000), you get superior resolution and color in your graphic slides—clearly the best of the film recorders reviewed here. It takes a big machine to get top performance: the PCR stands 3 feet tall and weighs 42 pounds.

floor space. It's a good thing that it rolls around, because it weighs 42 pounds.

One of the reasons the PCR is so big is the size of its internal CRT. The tube is more than 13 inches long and has a 7-inch-diagonal screen face. The sheer size of this tube helps the PCR create very sharp text and graphics. It operates at either 2K or 4K resolution, which is software selectable.

Installing the board that controls the

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Shuttle
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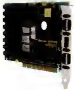
- $595 list price



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CIRCLE 177 ON READER SERVICE CARD

PCR can be a bit tricky. For starters, if you are putting the MVP-PC (Matrix Vector Processor) board into a computer with 640K of RAM, you first have to reduce the memory to 512K because the MVP-PC board requires the space in memory between 512K and 640K for its operation. However, the MVP-Star board, which at 12 MHz is a faster version of the 8-MHz MVP-PC, does not use that 128K conventional memory space, thereby eliminating any memory conflicts.

There are four sets of jumpers on the MVP boards. The factory settings are fine if you're using an IBM PC-XT or 100-percent compatible, but if you're using an IBM PC AT, a compatible, or an AT&T 6300, you'll have to change the jumper settings using plastic connectors with a short wire between them. Once this is done, you have to install a plastic guide for the back end of the board and connect a short GPIB cable to its side. Because the GPIB cable does not attach to the front end of the board and there is a nonremovable cover plate on the board, the cable has to loop over the other boards and out the cable-cover-plate opening. The last thing to do is connect the GPIB cable to the interface cable connected to the PCR.

> ■ The Matrix PCR's only installation requirement is to plug in the cables.

The PCR itself requires virtually no installation. The camera is bolted into place just below the control panel, pointed downward at the internal CRT. All you have to do is plug in the power cable and connect the 6-foot-long interface cable.

The software installation is somewhat arcane, making the first interaction with the recorder that much more ungainly. After you choose to run in foreground or background mode, you go through a series of prompted questions, a number of which are very technical—dealing with the guts of computing in a way that few business users will understand. Thankfully, almost all of the default settings are right for the IBM PC AT that we used to test the machine. The manual does a decent job of telling you which alternatives to pick without explaining such things as IRQ lines, binary and hexadecimal, notation, or disk interleaving.

I ran the PCR in background mode and controlled the imaging process from the *Mirage* graphics program, so I didn't have to reconfigure the controller software. If

FACT FILE

Matrix PCR
Matrix Instruments Inc.
1 Ramland Rd.
Orangeburg, NY 10962
(800) 852-8533
(914) 365-0190 (in N.Y.)

List Price: $13,790 with MVP-PC graphics board; $14,290 with MVP-Star graphics board.

Requires: 512K RAM, MVP board, 100 percent XT or AT compatible with hard disk drive, DOS 2.1 or later.

In Short: The PCR delivers the finest-quality slides of any recorder under $15,000. It produces crisp images, smooth text, and bright colors. However, the PCR suffers from tricky installation, arcane controller software, and a high price. Its performance results are unsurpassed for a film recorder in this price range.

CIRCLE **667** ON READER SERVICE CARD

you choose to run in foreground mode, you can handle extremely large files, but your images have to be in Matrix's Scan Conversion Object Description Language (SCODL) before they can be shot. If you're recording in background mode, the PCR driver in your graphics package does the conversion from its format to SCODL for you.

In all, it takes somewhere between 40 and 60 minutes to install the PCR—from the time you take it out of the box until it is ready to run.

The last bit of complication with the PCR came when I had to send the appropriate switch files to the film recorder as part of the setup in *Mirage*. You must send two switch files: one selects 2K or 4K addressable resolution, overriding the controller software configuration; the other is the compensation file for Kodak Ektachrome ASA/ISO 100 35mm slide film.

■ Creating a batch routine for the PCR makes sending switch files much easier.

Other switch files controlling the film recorder are sent as copy commands at the MVP subdirectory prompt. With them you can load the brightness and calibration tables for Polaroid High-Contrast Pola-Chrome slide film, set large table sizes for processing thick edges or complex images, or force an immediate calibration. Besides giving you great flexibility, the switch files let you run other output devices from the MVP board, such as the Matrix TT200 thermal transfer printer or the Hewlett-Packard LaserJet Plus. You can create a batch routine to make sending switch files much easier.

Once all the configuration work is out of the way, the PCR operates in a very straightforward manner. The Pentax camera body included with the PCR is easy to load. After pulling the film across the camera so it lines up with the sprocket teeth, you close the camera and press the Function and Select buttons on the control panel, one after the other. This automatically advances the film to the number-one frame position.

The three buttons on the front panel of the PCR—Function, Select, and Reset—allow you to use some of the internal functions without going to the software. For example, you can unload the film, enable the automatic calibration, set GPIB addresses, or record certain test patterns. The Reset button resets the system and moves the colored glass lenses to the neutral position. LED lights on the front panel tell you when the recorder is shooting a frame and which color lens is active, as well as indicating faults and errors.

> ■ The slides the PCR produces are truly wonderful—in either 2K or 4K resolution.

The slides the PCR produces are truly wonderful—in either 2K or 4K resolution. The edges of images and text characters are sharp and clear, with only the slightest hint of roughness in curving forms in 2K. You can also see some faint banding in graded color backgrounds in 2K. In 4K these imperfections vanish.

The speed of the PCR also changes when you move from 2K to 4K resolution. In 2K the recording is relatively fast—our simple text slide, TEXT1, took a little over 2 minutes to expose. But in 4K this same slide took well over 7 minutes—a bit on the slow side. Our most complex slide, GRAPH2, showed less variance, taking about 15 minutes to record in 2K and about 20½ minutes in 4K.

The colors in both resolution modes are evenly saturated, bright, and true. Part of the reason for the fine coloring is that the PCR recalibrates itself automatically on start-up, and reset, and after every five frames or 1 hour, whichever comes first. The PCR handles a color palette of more than 16 million colors and will print up to 256 on a slide.

Although the PCR is on wheels, it is

very stable. Even when I jostled it severely and pushed it around during recording, the slides were unaffected.

The PCR is not a snap to install and configure, and it's expensive. But if your main concern is quality, there is none better—unless you're willing to spend at least $25,000. Its images are crisp, its text is almost perfectly smooth, and the colors are rich, pure, and bright. If you do a lot of formal presentations, this machine is an excellent choice.—**Henry Fersko-Weiss**

- No film recorder under $25,000 can beat the Matrix PCR for quality.

MATRIX INSTRUMENTS INC.

Matrix ProColor

The ProColor, which shipped in July 1988, is the most junior member of the Matrix family of digital film recorders. Its price tag of $7,990 is about half that of its brother recorder, the PCR, and one-quarter that of the QCR. But like the other Matrix recorders, the ProColor produces excellent slides—only somewhat less excellent than the PCR and at a tad slower speed.

There is very little family resemblance between the ProColor and its brethren. It isn't a floor model, as are the PCR and QCR. Instead, it is shaped like a microwave oven and is intended for the desktop. Since it takes up 20.5 inches by 14.7 inches, you'll need a large desk. It also weighs

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Matrix ProColor
Matrix Instruments Inc.
1 Ramland Rd.
Orangeburg, NY 10962
(800) 852-8533
(914) 365-0190 (in N. Y.)

List Price: $7,990 with MVP-PC graphics board; $8,490 with MVP-Star graphics board. Cables and software included.

Requires: 512K RAM, MVP board, 100 percent XT or AT compatible with hard disk drive, DOS 2.1 or later.

In Short: The ProColor is the latest addition to the Matrix line of film recorders. Like the PCR, installation and software could be improved, but they are offset by excellent results. The ProColor produces very fine slide output in both 2K and 4K resolution. With good colors and clear text, it's probably the best value for its price range.

CIRCLE **666** ON READER SERVICE CARD

THE MIRUS FILMPRINTER ADVANCES THE STATE OF THE ART

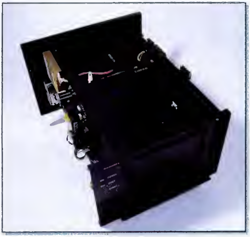
All digital film recorders operate with the same basic hardware: an internal CRT, a color wheel, a lens, and a camera. What distinguishes one from another is the imaging technology. Last October, however, Mirus Corp. introduced a film recorder with a new technological approach: direct digital imaging. This gives the Mirus FilmPrinter digital control over the computer interface, dot positioning on the internal CRT, and dot recording. It also promises rich, true colors across a palette of more than 16 million, and it offers an addressable resolution of 8K—the highest of any desktop model.

The Macintosh version of the FilmPrinter shipped first; a PC model is due out this quarter. Both should retail for

Inside the Black Box: ProColor vs. FilmPrinter Technology

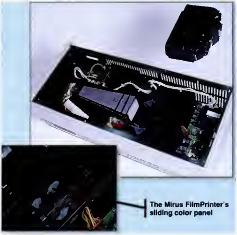
Matrix ProColor

The Matrix ProColor uses the conventional configuration associated with film recorders. The 35mm camera body is mounted in the front of the chamber that houses the color wheel and the CRT. The CRT provides resolutions of up to 4K on a 7-inch-diagonal screen. On the left and right sides of the unit are the logic boards and the power supply.



Mirus FilmPrinter

The design of the Mirus FilmPrinter is very sleek and compact. Unlike the ProColor, it has a camera mounted on top of the unit yet inside, keeping it hidden and protected. (Here we show the camera suspended in position but without the plate that normally secures it in place.) Because the camera is mounted on top with the lens pointing down, a mirror is used to reflect the image from the CRT to the camera at 90 degrees. The CRT is a small, high-resolution 7-inch tube with a $2\frac{1}{2}$-inch-diagonal screen. As shown in the detail shot, it uses a sliding color panel rather than the conventional color wheel that most film recorders use .



The Mirus FilmPrinter's sliding color panel

FACT FILE

Mirus FilmPrinter
Mirus Corp.
445 S. San Antonio Rd.
Los Altos, CA 94022
(800) 654-0808
(415) 949-5544 (In Calif.)
List Price: $5,895 (with MirusImage-DOS). *MirusImage Windows*, $295.
Requires: 512K RAM, parallel port.
CIRCLE **663** ON READER SERVICE CARD

$5,895. An OEM version of the PC model will be available from Polaroid first. The Polaroid machine, called the Bravo Computer Slide Maker, has a different outer skin and a slightly higher price: $5,995. (These preliminary prices are subject to change.)

Although we could not see a production version of the FilmPrinter, we did test a late preproduction version. The color tables were still being worked on at the time, but the resolution was excellent—rivaling that of the best desktop film recorders on the market. Just before we went to press, Mirus shot our complex graphics test slide at its factory. The colors were evenly saturated and true to the original image at every resolution setting—indicating that the color tables had finally been perfected.

HIGH RESOLUTION To get so many colors at such high resolution, the FilmPrinter uses digital techniques to position the dots on a proprietary internal CRT. But what really distinguishes the FilmPrinter is its dot-recording technique. An electron beam of constant intensity is directed at dots in a line to illuminate them. To create different colors (different intensities of light filtered through the color wheel), the electron beam is run across each line repeatedly.

A fully saturated color on 35mm ASA/ISO 100 Ektachrome slide film requires the electron beam to make about 300 passes of a line. By eliminating analog modulation of beam intensity, the FilmPrinter achieves a great deal of precision in mapping colors.

The downside of this approach is that it takes longer to record the image; the FilmPrinter is slow. By limiting the resolution, however, users have some control over the speed. The FilmPrinter offers 15 different resolution selections, from 600 dots per line up to 8K. The lower the resolution, the faster the speed. The quality of the images is so good that a 2K setting produces slides equal to the 4K resolution of some other recorders. For informal presentations, even lower resolutions may be acceptable.

SLEEK DESIGN The people at Mirus have also paid a lot of attention to the FilmPrinter's packaging. The internal CRT is small, so the recorder's box is only 19.1 inches wide, 8.5 inches deep, and 5.5 inches high. It weighs 16 pounds. The camera is set into a well on the top of the recorder, along its width. Because the camera points downward, perpendicular to the internal CRT, a mirror reflects the image onto the film. The camera well is covered by a hinged plastic top, hiding the camera from view, so the recorder doesn't look out of place on a corporate desktop.

The menu-driven controller software for the FilmPrinter will come in Macintosh, DOS, and *Microsoft Windows* versions. It will accept images in *AutoCAD* .DXF format, .CGM, HPGL, Lotus, and VideoShow .PIC format, and Zenographics' .ZGM.

If the FilmPrinter's production versions deliver on all its promises, this could be a very important machine. It combines the widest possible range of colors with extremely high addressable resolution and a very competitive price. Look for it.—**Henry Fersko-Weiss**

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38 pounds, so you're not likely to be lifting it on and off your desk regularly—unless you make it part of your exercise regimen.

Like the PCR, the ProColor is controlled by the MVP board and software. So, also like the PCR, the installation and configuration are somewhat "techy" (read the PCR review for details). But the manual for the ProColor is much friendlier than that for the PCR. Its 46 pages are abundantly illustrated; it is clearly written and includes a list of error codes, a glossary of terms, and an index.

The ProColor comes standard with a 35mm Pentax camera. The camera body is embedded in a metal plate, with a fixed lens on the other side. The plate fits into a recessed area on the front panel and is secured with a ring clip that is easy to turn, although placed in a slightly awkward position—too close to the top of the camera. A short cable with a keyway connector plugs into the front panel to complete the camera installation.

■ Although the ProColor is very new to the film recorder market, it can work with more than 30 graphics programs.

The Polaroid 3 × 4 Instant Camera, costing an extra $1,095, also works with the ProColor. You can use it to proof pictures before making slides or to print handouts to accompany a slide presentation.

On the front of the ProColor are three LED lights: Power, Busy, and Error. The yellow Busy light pulses very rapidly while a slide is being recorded. If you watch it carefully, you can tell when the color lenses change because the light goes out briefly and you can hear a clicking sound inside. The ProColor also uses a beeper to signal you for certain conditions. After start-up or reset, a ½ second beep tells you it's ready to use. Four short beeps indicate the end of a recorded image, a

The Matrix ProColor got a score of "Excellent" in the PC Magazine *slide show competition on the simpler text and graphics images—not bad for the junior member of the Matrix family of recorders whose price of $7,990 is about half that of the Matrix PCR.*

continuous series of short beeps tells you that the recorder is out of film, and a series of long, warbled beeps indicates an error.

The slides produced by the ProColor are very good either in 2K or 4K resolution. As with all film recorders that can shoot in both of these addressable resolutions, the difference is not dramatic. But the edges of text characters are somewhat fuzzier, border lines appear thicker, and there is more evidence of background banding when shooting the slides in 2K.

Both 2K and 4K resolution modes produce slides that are slightly less sharp than those from the PCR film recorder. The color in the ProColor slides is also quite good, with the colors recording very evenly. Although based on the same 16 million color palette and 256 colors per slide as the PCR, the ProColor renders slide colors that are slightly duller than those in the slides the PCR produces.

One of the reasons for the differences between the PCR and ProColor is the internal CRT—the tube in the ProColor is only about half as long. This makes it more difficult to focus the beam of light accurately, and it leads to slightly larger pixels.

The ProColor is also slower than the PCR—but not by a significant amount in many instances. The simplest text slide, TEXT1, showed the biggest difference in recording time in 2K resolution: the ProColor took 3.73 minutes and the PCR 2.17 minutes. While the ProColor shot some of the slides in 4K resoltuion in almost exactly the same time, others were about 44 percent slower. Overall, the ProColor was a little slow with the simple images and fast with the complex images.

Although the ProColor is very new to the film recorder market, it can work with more than 30 graphics programs because it uses the same board and controller software as the PCR. It comes with Times and Triumvirate fonts in normal and bold types, which can be used instead of software fonts. As with the other film recorders reviewed here, using hardware fonts makes recording that much faster.

To add to all its fine features, the ProColor has a 1-year warranty—longer than any of its competitors. Given its $7,990 price tag and the high quality of its output, it may not be too long before it outsells the rest of the Matrix family of recorders.
—Henry Fersko-Weiss

POLAROID CORP.

Polaroid PalettePlus

Polaroid ushered in a new era in home photography when it realized that quick, cheap, and easy was more important to many people than high quality. It's not surprising that it has had a good deal of success in bringing this same approach to computer-generated photography with the Polaroid Palette. Since its release in 1983, the Palette has garnered the support of more than 35 graphics packages, making it one of the most widely supported film recorders on the market. The Polaroid Palette—and its enhanced implementation, the Polaroid PalettePlus—produce lower-quality output than do other film recorders. But at $2,999, the price is lower too, making in-house computer-generated slides and prints a reality for those with limited budgets.

A key element of the PalettePlus's success is its simplicity. Connecting the cables, installing the camera, and loading the film are straightforward processes. There's even a setup demo disk that guides you through unpacking and setting up the equipment step by step, giving you on-screen illustrations of how to hook up all cables. This should help technophobes feel more at ease. The demo covers only the installation of the 669 film camera (used to create self-developing prints and transparencies), though, and ignores the 35mm camera.

The PalettePlus is an analog film recorder and so works by intercepting the signal sent to your monitor and generating photographs from it. (It is the only analog film recorder we review here.) This means the resolution of your monitor limits the

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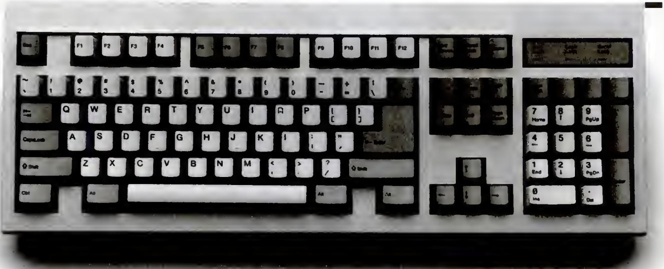

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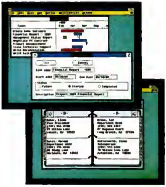

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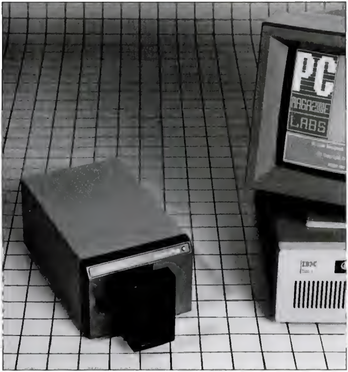


The Polaroid PalettePlus offers a classic tradeoff: it produces slides of noticeably lower quality than the competition, but it does so much faster and at a for lower cost. Another advantage is simplicity; setup and operation are straightforward and easy.

FACT FILE

Polaroid PalettePlus
Polaroid Corp.
Presentation Products Group
575 Technology Sq.
Cambridge, MA 02139
(800) 225-1618
List Price: $2.999
Requires: 512K RAM, serial port, graphics card, and monitor.
In Short: The Polaroid PalettePlus cannot compete with high-resolution film recorders when it comes to output quality. But its low price, easy-to-use design, and great flexibility,make it hard to beat if high-quality output isn't your primary concern. Software not copy protected.

CIRCLE **665** ON READER SERVICE CARD

output resolution. The PalettePlus can fill in the areas between raster lines to increase the resolution on CGA systems to 640 by 400, and it boosts the resolution on EGA systems to 640 by 700. But it still falls well short of the 2K or 4K horizontal resolutions standard with digital film recorders.

With an EGA system, you're limited to 16 colors in a single picture, although four different color palettes allow 72 available colors altogether.

You can send images to the PalettePlus directly from your graphics package, selecting all options such as film type and exposure from within the package. Or you can use the controller software to call up graphics files saved to disk in the correct format. The program lets you preview the picture on-screen and alter the colors if you wish. You can also alter camera settings and then send files to the camera one at a time or in batches.

If you should ever want film output from a graphics package that doesn't support the PalettePlus, you can turn to the memory-resident screen-grabber utility included with the film recorder. Once this utility is loaded in memory, you can start your graphics program (or any other type of software) and work with it normally. When you have a screen ready to save, a two-key combination calls up the screen-grabber menu. This lets you send the image to the PalettePlus, to your printer, or to a disk file. You can even edit each color individually, with the changes shown immediately on-screen. The resolution of any resulting photographs will be the same as that of your monitor.

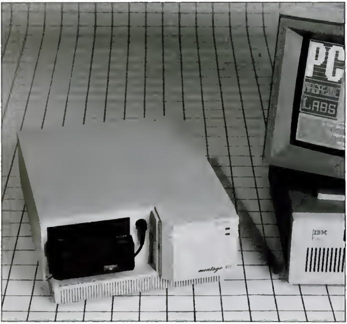
The PalettePlus comes with a pack film back for exposing Type 669 instant color print or Type 691 mini-overhead film for producing prints and transparencies and a 35mm camera for creating slides. Neither camera has a viewfinder, and the 35mm camera has no setting controls or film advance button. This makes for less flexibility but also means there's no danger of inadvertently setting the camera controls incorrectly. However, the 35mm camera does have automatic film loading, advancing, and rewinding. And switching from one camera to the other is quite a simple matter. Polaroid also offers an optional CB33 camera back for exposing AutoFilm Type 339 film for about $300. Type 339 film self-develops in normal room light without any need for peeling or timing.

You also get a Polaroid 35mm PowerProcessor for developing Polaroid instant slide film and a Polaroid 35mm illuminated slide mounter. This means that if you use the included PolaChrome slide film, you can go from graphics files on-disk to finished slides in a matter of minutes—without the need for a professional developer. But, Polaroid admits that you should use Kodak's Ektachrome ASA/ISO 100 for best-quality output rather than its own PolaChrome film.

As one might expect from a relatively

low-resolution film recorder such as the Polaroid PalettePlus, text and outlines of shapes tend to be jagged. The PalettePlus often compensates for its limited number of colors by resorting to fill patterns instead of solid colors. This gave the maroon background of our GRAPH1 test slide a washed-out appearance and made much of GRAPH2 appear grainy. On the positive side, it reproduced shapes quite accurately and approximated the original colors fairly well within its limitations. It even gave a reasonable rendering of continuously graded background colors.

The Polaroid PalettePlus can't compete with digital film recorders when it comes to output quality, but for ease of installation and ease of use it can't be beat. The huge number of graphics packages that support it, the screen-grabber program, and the equipment supplied for developing your own slides and prints offer certain advantages. If price is a barrier and these things concern you more than high-quality output, then the PalettePlus may appeal to you.—**Robert Kendall**



The $5,995 Montage FR1 can take a Polaroid 339 instant camera. But for quality slides you'll want a 35mm camera. You'll also want the 2MB of extra memory that Presentation Technologies sells for an additional $1,000 if you plan to do very complex graphics.

PRESENTATION TECHNOLOGIES

Montage FR1

Back in March 1986, Presentation Technologies came out with its first film recorder for the PC: the ImageMaker. This machine, which received sparkling reviews in several publications (including this one), produced sharp, high-quality text slides by projecting a beam of light through characters on a disklike "font cartridge."

Times have changed, and although companies still need good text and simple graph charts, most are now expecting more flexibility for their dollars. In response to this new market, Presentation Technologies has added to its inventory the Montage FR1, at $5,995, a more conventional raster-based film recorder.

The Montage FR1 is a medium-sized, slick-looking unit. A front side-opening door hides the 35mm camera that comes mounted with the unit; there are instructions for removing it if you want to replace it with a Polaroid 339 instant camera. On the right of the door are two LEDs: one green labeled On, and one red labeled Alert, which lights up only if there is a problem. The former blinks slowly during the 20-minute warm-up procedure, quickly during operation, and steadily when the machine is on but not in use. The unit comes with two helpful and well-illustrated manuals, one each for the board and the recorder, making it very simple to get the machine up and running.

The Montage FR1 uses the same Lasergraphics Rascol II board as the LFR to interpret the graphic data and send it to the recorder via a high-speed parallel port. The board features the same software that Lasergraphics provides, including two controller programs. One program, specifically for the Targa board, contains optional fonts, and the other allows you to change several default options, including language, film type, color saturation, and the number of colors the recorder will use. (The "fast" option will use only 2 million colors, while the "fine" option will allow you to use the full range of 16 million.) Before operating the recorder, you simply load the software into RAM, where it re-

PC FACT FILE

Montage FR1
Presentation Technologies
743 North Pastoria Ave.
Sunnyvale, CA 94086
(800) 345-7050
(408) 749-1959
List Price: $5,995, ($6,995 with 2MB RAM on Rascol II board).
Requires: 256K, hard disk suggested.
In Short: Presentation Technologies' new film recorder produces high-quality text and graphics slides that leave its older ImageMaker film recorder sitting in the dust. The Montage FR1 operates in both Apple Macintosh and IBM PC environments.

CIRCLE **664** ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

• Matrix ProColor

The ProColor, from Matrix Instruments, manages to combine superior quality output with a reasonable price and the longest warranty in the industry—a formula that makes it the editor's choice. But two other film recorders, Lasergraphics' LFR and Matrix's PCR, were close contenders. Both of these recorders produced slightly better slides than the ProColor did, but they cost close to twice as much. Also, the LFR uses a proprietary imaging language that isn't as well supported by popular graphics programs.

The ProColor offers a 2K or 4K addressable resolution and a color palette of over 16 million colors. The slides it produces have sharp lines—with only a hint of the jaggies in angled lines—no blurring of text, no banding, and evenly saturated, intense colors.

One of the main reasons for the ProColor's excellent quality is its 7-inch (diagonal) internal CRT screen. However, this CRT size contributes to its fairly chunky desktop size.

Because Matrix uses the same MVP board and software for the ProColor that it uses for its QCR and PCR recorders, more than 30 graphics programs have drivers for the ProColor, making it one of most widely supported recorders available. It is also well supported by different levels of service contract and a 1-year warranty.

At a cost of $7,990, the ProColor is quite appealing.

mains invisible throughout the process of creating and outputting graphics to the film recorder. And like the LFR, the Montage FR1 can support a Mac and an IBM PC simultaneously.

Presentation Technologies sends out the Rascol II board with half a megabyte of memory, adequate for most business slides. However, it does not suffice for more complex graphics; the unit choked on the PC Labs GRAPH2 test file, producing a slide that was missing several elements. Users who will be producing larger-sized files have the option of buying the system with up to 2MB of memory on the Rascol II board for an extra $1,000. Presentation Technologies is also working on an addition to the software that will signal the user if there is not enough memory to produce the entire image.

When you do have enough memory, the Montage FR1 produces high-quality slides, though not quite as sharp as those produced by the LFR. Its timing was almost identical to that of the LFR's; the "fine" graphics were only slightly slower than the "fast" on the complex slides, making "fast" worthwhile to use only if you want to save a couple of minutes producing a slide of your next bar graph.

Presentation Technologies has not abandoned its first film recorder and is still selling the somewhat updated ImageMaker Plus. Unfortunately, the machine has not changed much since its introduction 2 years ago: although it can produce high quality text slides using certain software packages (for example, the company's own *Imagemate*), it can handle only the most structured graphics and so is of very limited business use.

We tested the ImageMaker Plus on the PC Labs simpler text file, TEXT1, achieving rather unpromising results: it took approximately 40 minutes to process a badly colored TEXT1 test file (the same file took the Montage FR1 about 3½ minutes), and it absolutely refused to handle either of the nontext files.

It is certainly commendable when a company refuses to orphan a popular product. However, there may be few customers who will want to purchase the ImageMaker Plus for $4,995 when, for $1,000 more, they can access the flexibility and power of the vastly superior Montage FR1.—**Barbara Krasnoff**

Henry Fersko-Weiss is a frequent contributor to PC Magazine. *Barbara Krasnoff is a regular contributor to* PC Magazine. *Robert Kendall is a regular contributor to* PC Magazine.

Some views on why the NEC MultiSync

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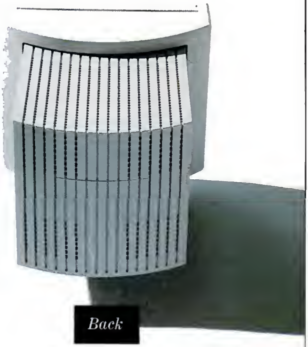

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Side

Top

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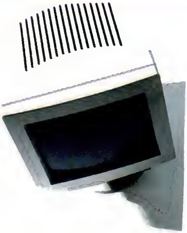

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MultiSync 2A. One super VGA monitor.

VGA mode shown at 320 X 200

C&C
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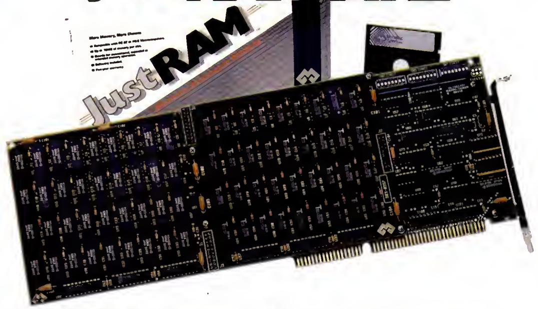

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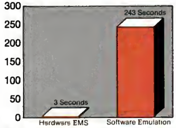
JustRAM Hardware EMS Memory Outperforms Software Emulation 80 to 1



Comparison based on a test program designed to simulate a large database sort. The test was devised and conducted by *PC Magazine*. (See "Expanded Memory Emulators" March 31, 1987.)

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PRODUCTIVITY

■ **UTILITIES** ■ BOB FLANDERS

FILE TRANSFERS FAST AND EASY

Moving files between machines that lack a common disk format can present a formidable challenge. ZCOPY provides the answer with a versatile high-speed serial link.

Imagine, if you will, that a brand-new IBM PS/2 is sitting on your desk. All that 20-MHz 386 power is yours to command just as soon as you copy the files over from your old AT. Reality breaks into your reverie, however, when you realize that your PS/2 has no 5¼-inch drive and your AT has no 3½-inch drive. Just how do you transfer your data to the PS/2?

Fortunately, this issue of *PC Magazine* has also reached your desk, bringing with it the ZCOPY utility. ZCOPY lets you transfer data directly between machines through serial ports operating at high speed. This eliminates the problems that arise either when your computers lack a common medium or when the data files won't fit on a medium that they do share.

As each file is transferred, it is checked for errors and its data is buffered and then written to the receiving machine's disk. ZCOPY monitors the number of data errors it has to correct during the transfer, and if this gets too high, the program automatically resets the sending and receiving machines to the next lower speed.

ZCOPY supports filename wildcards and it can be set to skip, automatically overwrite, or prompt the operator when a same-named file exists on the receiving machine. If a file is found that won't fit on the recipient's disk, ZCOPY can be set either to halt the program or to skip that file.

In order to use ZCOPY, both your machines must be reasonably IBM compatible and each must have at least one serial port. ZCOPY will work only with the COM1 and COM2 ports. The two machines must be connected via a null-modem cable, as shown in Figure 1. Note that unlike the DOS COPY command, ZCOPY does not allow files to be renamed as they are transferred. Further, unlike DOS's XCOPY, the ZCOPY utility cannot create subdirectories on the receiving machine's disk. Any subdirectory into which files are to be transferred must exist before the program is run. If ZCOPY is unable to find a needed subdirectory, the program will abort with the appropriate error message.

PRODUCTIVITY INDEX

UTILITIES
ZCOPY lets you move files easily between different computers.
ENVIRONMENTS
The "window procedure" function is often the core of the PM program.
POWER PROGRAMMING
Ray Duncan begins a series on file management.
SPREADSHEET CLINIC
Macros that save a cell pointer's current position and return to it.
USER-TO-USER
Automatically track who boots your PC; how TYPE works with wildcards.
POWER USER
Print footnotes in a different font and compressed type on a LaserJet.
LANGUAGES
Dial a phone with BASIC and a modem; interpret function keys.
PC TUTOR
Learn why the Abort option doesn't work when accessing a floppy disk.
CONNECTIVITY CLINIC
Track *NetWare* log-ins and log-outs; an easier way to use *1-2-3* on a LAN.

The easiest way to get a copy of ZCOPY.COM is to download it from PC MagNet, as explained in the accompanying sidebar "ZCOPY by Modem." Since ZCOPY is itself the program you'll subsequently use to allow machines with incompatible disk formats to communicate with each other, separate downloads onto each machine will simplify setting things up. The sidebar "Transferring ZCOPY Without a Diskette" provides an alternative, however, in the form of a relatively short DEBUG script that will let you transfer ZCOPY via serial ports. ZCOPY.ASM, the assembly language source code, is printed later in this article. To create ZCOPY.COM from the ZCOPY.ASM source code requires use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM ZCOPY;
LINK ZCOPY;
EXE2BIN ZCOPY ZCOPY.COM;
```

If you don't have a macro assembler but want to keyboard the program yourself, ZCOPY.BAS, also printed here, will automatically create ZCOPY.COM when you run it in BASIC. Both the .ASM and BAS files for ZCOPY are also available for downloading from PC MagNet.

USING ZCOPY ZCOPY.COM must be invoked (and must therefore reside where DOS can find it) on both the sending and the receiving machines. Its full syntax is

```
ZCOPY source [target] [/w][/n][/u][/o]
 [/a][/p][/d]
```

On the sending side the *source* is a filespec (filename, plus any needed drive and subdirectory information), and a *target* (either COM1 or COM2) must be specified. On the receiving side the *source* is a COM port, and no target (other than a directory path) may be specified. ZCOPY allows 30 seconds (the default) for the two machines to connect with each other; the program aborts if a timeout occurs. Again by default, the program prompts the operator for confirmation before overwriting a same-named file on the receiving machine. Transferred files retain their original date and time under the default conditions.

The various optional command-line switches allow you to tailor ZCOPY's operation to your specific needs. The /w option may be used on either machine to instruct that machine to wait indefinitely to connect rather than timeout at the end of 30 seconds. If the /w switch is used, hitting Ctrl-Break tells the affected machine to stop waiting for the other node to come alive.

ZCOPY initially tries to use a 115-kilobit-per-second transfer rate between machines. The speed is successively stepped down if necessary until the two machines can be successfully synchronized. This default starting speed corresponds to a value of 1 for the /n switch. If you know that a particular machine won't work at such a high transfer rate, however, you can specify a lower initial seeking speed by using other values for /n. The IBM PS/2 Model 80, for example, has a maximum speed of 57.6 kilobits per second, which is /2. The rates for /3 through /6 are, successively, 38.4, 19.2, 9,600, and 4,800 kbps. Note that the /n switch, if used, must be used on the ZCOPY command line of both machines.

The /w and /n switches affect the sending and receiving machines *before* the connection is established. The other optional command-line switch changes *after* the connection and may be entered on the ZCOPY command line of either or both machines (they're ORed together). For example, the command lines shown below (sending on the left, receiving on the right) are functionally identical:

```
ZCOPY *.* COM1 /U /A     ZCOPY COM2 /P
ZCOPY *.* COM1 /P        ZCOPY COM2 /U /A
```

The /u (Update) switch is used to permit same-named files on the receiving machine to be overwritten without the confirmation prompt if the *source* file is newer than the destination file. To suppress the confirmation prompt on all files, regardless of date, use the /o (Overwrite) switch option.

The /a (Abort on Full) option stops the copying process immediately when the designation disk becomes full. (The default condition simply skips that file and continues looking for a smaller one that will fit.)

The /p (Pause) switch inserts a pause after the connection between machines is made but before the transfer process begins. This is used to permit you to change a disk, for example.

Finally, the /d (Date) parameter may be specified to cause the receiving machine to put its own current time-date stamp on files transferred to it rather than preserve their original dating.

UNDERSTANDING ZCOPY ZCOPY is actually two separate programs in one complete package. The first program is run on the sending machine, which becomes the master node. The master sends requests to the slave node to execute various functions and subsequently looks for responses from the slave that indicate the re-

The Null-Modem Cable

The null-modem cable is simply two DB-25 connectors joined by a length of cable. It eliminates the need for a modem when connecting two computers directly. The wires for pins 2 and 3 are reversed from one connector to another. This allows each computer to send data on what it sees as pin 2 and receive data on what it sees as pin 3.

Pin 7 (the ground) is wired directly from computer to computer. Pins 4, 5, and 8 (Request to send, Clear to send, Carrier detect) are wired together at each end, as are pins 6 and 20 (Data set ready and Data terminal ready). With these minor wiring arrangements, two PCs can communicate directly without a modem.

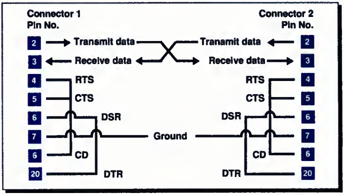

Figure 1: *A null-modem cable connects the serial ports of the sending and receiving machines when using the ZCOPY file-transfer utility.*

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sults of those functions.

The second program in the package is run on the receiving machine, which becomes the slave. The slave machine waits for a request block that contains the function the machine is supposed to execute. After executing the function, the result of the function is sent back to the master machine.

Although its implementation is somewhat complicated, ZCOPY essentially performs four functions:

- Speed seeking
- File send/receive with protocol
- Error handling
- Operator interface

I will discuss each of these functions in depth beginning with speed seeking.

TRANSFERRING ZCOPY WITHOUT A DISKETTE

Not having a common medium can inhibit the exchange of programs as well as data files. You might even find yourself in this bind with ZCOPY—the transfer program itself may be on a medium that cannot be read by your other machine. If this happens, here's an alternative: a DEBUG script that lets you transfer ZCOPY through the serial ports.

(1) Connect the two machines together via the null-modem cable. You must know which communications ports you are using.

(2) At each machine, set the communications port to the same communications parameters by using the mode command

```
MODE COM1:1200,N,8,1
     -or-
MODE COM2:1200,N,8,1
```

(3) On the machine to receive ZCOPY, enter the script in Figure A (without the semicoloned comments) in DEBUG. *Note: This must be done before activating the sending machine.*

(4) On the machine to send ZCOPY, follow the steps in Figure B.

ZCOPY is now on the receiver machine.—**Bob Flanders**

```
A>COPY CON TMP.DBG          ; Build the debug script
n zcopy.com                 ; Name of the received program
a 5000                      ; Assemble at a high address
CALL    5016                ; Get low character of count
MOV     CL,AL               ; cl = low byte
CALL    5016                ; .. Get high character
MOV     CH,AL               ; cx = length of program
PUSH    CX                  ; .. save it
MOV     DI,0100             ; di -> output area for program
CALL    5016                ; Get program character
STOSB                       ; Store it
LOOP    500E                ; .. Loop until all received
POP     CX                  ; cx = length for write
INT     3                   ; .. return to debug
ADD     DX,+05              ; dx -> line status register
IN      AL,DX               ; al = lsr value
TEST    AL,01               ; q. any data available?
JZ      5019                ; a. no .. loop until ready
SUB     DX,+05              ; dx -> data register
IN      AL,DX               ; get the character
RET                         ; return w/al = character
                            ; blank line to stop the assembly
r dx                        ; set dx ...
3f8         ;<== Note: Use 3F8 for COM1, 2F8 for COM2
g =5000                     ; start the program
rip                         ; tell DEBUG where to write from
100                         ; .. address 100 hex
w                           ; write out ZCOPY.COM
q                           ; .. and back to DOS
^Z           ;(or use F6)
A>debug <tmp.dbg
```

Figure A: *Enter this DEBUG script onto the machine that is receiving ZCOPY. Remember, this must be done before activating the sending machine.*

```
A>debug zcopy.com       ; bring in zcopy
-rdx                    ; setup the comm port
:3f8           ; <== Note: This would be 3F8 for COM1, 2F8 for COM2!
-g =103                 ; call the self-transfer routine
               ; (30-40 seconds will pass here)
AX=00CC  BX=0000  CX=0000  DX=03F8  SP=FFFE  BP=0000  SI=1354  DI=0000
DS=1FE1  ES=1FE1  SS=1FE1  CS=1FE1  IP=1353   NV UP EI PL NZ NA PO NC
1FE1:1353 CC            INT     3
-q
A>
```

Figure B: *Enter the DEBUG script shown above on the machine to send ZCOPY.*

WhatsHot

From the advanced design studios of sunny Southern California comes a new version of super performance. New breakthroughs in lightweight materials give pedal pumping a technological twist. New designs on the boards feature superlight aluminum alloys and carbon skins. The tough angular shapes of traditional bike frames, pedals and gears are giving way to sleek contours that rival those of an exotic Italian sports car.

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```
;-------------------------------------------------------------------
; ZCOPY - Transfer files via the COM port.  Syntax is
;-------------------------------------------------------------------
CBEG          SEGMENT PARA PUBLIC 'CODE'
              ASSUME  CS:CSEG, DS:CSEG, ES:CSEG, SS:CSEG
              ORG     100H
START:        JMP     BEGINNING               ; go to start of program
              JMP     ZCXFER                  ; transfer self

COPYRIGHT     DB      "ZCOPY 1.0 (c) Copyright 1989 Ziff Communications Co."
              DB      13,10,"PC Magazine ",254," Bob Flanders",13,10,"$",26

BIOS_DATA     EQU     40H                     ; bios data segment
TIMER_LOW     EQU     WORD PTR 6CH            ; offset of low word
TIMER_HI      EQU     WORD PTR 6EH            ; ... high word
LSR           EQU     5                       ; lsr register offset
LSR_DRDY      EQU     00000001B               ; data ready
LSR_ORUN      EQU     00000010B               ; overrun error
LSR_PRTY      EQU     00000100B               ; parity error
LSR_FRM       EQU     00001000B               ; framing error
LSR_BRK       EQU     00010000B               ; break interrupt
LSR_THRE      EQU     00100000B               ; transmit holding reg empty
LSR_TSRE      EQU     01000000B               ; transmit shift register emtpy
LSR_ERR       EQU     LSR_FRM+LSR_PRTY+LSR_ORUN  ; error conditions
LCR_SETUP     EQU     00000111B               ; set 8 bits, no parity, 2 stop
LCR_DLAB      EQU     10000000B               ; divisor latch access bit
MCR           EQU     4                       ; mcr register offset
MCR_OUT2      EQU     00001000B               ; out2 control bit
I8259         EQU     20H                     ; 8259 control register addr
EOI           EQU     20H                     ; 8259 end of interrupt command
I8259M        EQU     21H                     ; 8259 mask register
FLG           DB      0                       ; system operation flag
FLGR          EQU     80H                     ;  receiver mode
FLGO          EQU     40H                     ;  /o overwrite
FLGU          EQU     20H                     ;  /u update
FLGD          EQU     10H                     ;  /d set current date
FLGA          EQU     08H                     ;  /a abort on full
FLGP          EQU     04H                     ;  /p pause for diskette
FLGW          EQU     02H                     ;  wait forever for other system
FLG_SET       EQU     07EH                    ; flag mask on flg_set
FLG1          DB      0                       ; second flag
FLG1I         EQU     80H                     ;  system interrupts init'd
FLG1O         EQU     40H                     ;  output file is open
FLG1B         EQU     20H                     ;  break requested
FLG1S         EQU     10H                     ;  shutdown sent ok
XBUF_LTS      DW      0                       ; left to send
XBUFL         EQU     4000H                   ; buffer length
XBUF_WL       EQU     XBUFL-WBUFL-1           ; write when over this value
IO_LEN        EQU     512
XBUF_RBL      EQU     (XBUFL/IO_LEN)*IO_LEN   ; number of bytes to read
ERRORS        DW      0                       ; errors so far
MAX_ERRORS    EQU     3                       ; max retries before resync
SYNC_BYTE     EQU     08H                     ; first byte to sync on
SYNC_END      EQU     04H                     ; end of sync bytes
SYNC_LEN      EQU     128
SYNC_INC      EQU     11
CRC_VAL       EQU     01021H                  ; value for CRC
FNDOP         DB      4EH                     ; find first/find next op
; Note:  ** ZCPARM requires PARM_TBL to be in "OUDAPW" order
PARM_TBL      DB      'OUDAPW'                ; parameter specifications
ARG1          DW      0                       ; pointer to arg1
ARG2          DW      0                       ; pointer to arg2
WAIT_COUNT    DW      0                       ; timer tick counter
TIME_COUNT    DW      0                       ; timer inc amount
COM_STR       DB      "COM"                   ; com definition
BAUD_CNTR     DB      0                       ; baud rate counter
BAUD_TABLE    DB      1,'115k $',2,'57.6k$',3,'38.4k$',6,'19.2k$',12,'9600 $'
              DB      24,'4800 $'
LSR_VAL       DB      0                       ; lsr value after interrupt
LSR_NEW       DB      0                       ; lsr value is new flag
SEND_BLKNO    DW      0                       ; next block number to send
RCV_BLKNO     DW      0                       ; next block to receive
DFLDIR        DB      '.',0                   ; default receive directory
CURDIR        DB      ".\"                    ; current directory
FILENAME      DB      13 DUP (0)              ; work area for send filename
;-------message process table--------
MSG_P_TBL:
CRE_FILE      EQU     1                       ; create requested file
OPR_PROMPT    EQU     2                       ; display a prompt
SHUTDOWN      EQU     3                       ; end the program
MSG_ACK       EQU     4                       ; previous message ok
DATA_BLK      EQU     5                       ; block of data
EOF_MARK      EQU     6                       ; end of file mark
MSG_NAK       EQU     7                       ; previous message not ok
QRY_FLE       EQU     8                       ; query file existence
SET_FLG       EQU     9                       ; set flag bits
RESYNC        EQU     10                      ; resync
OPR_REPLY     EQU     11                      ; reply from oper
DIENOW        EQU     0FFH                    ; die immediately
DW OFFSET CRE_FILE_P,OFFSET ZCPPROMPT,OFFSET SHUTDOWN_P,OFFSET MSG_ACK_P
DW OFFSET DATA_BLK_P,OFFSET EOF_MARK_P,OFFSET MSG_NAK_P,OFFSET QRY_FLE_P
DW OFFSET SET_FLG_P,OFFSET RESYNC_P
SOH           EQU     01H                     ; start of header
STX           EQU     02H                     ; start of text
ETX           EQU     03H                     ; end of text
ACK           EQU     06H                     ; acknowledge
NAK           EQU     15H                     ; non-acknowledge
RLR           EQU     1DH                     ; request last response
LAST_RESP     DB      NAK                     ; last response holder
SEC_30        EQU     (18*30)+(2*3)           ; 30 seconds in ticks
SEC_10        EQU     (18*10)+(2*1)           ; 10 seconds in ticks
SEC_5         EQU     (18*5)+1                ;  5 seconds in ticks
SEC_3         EQU     (18*3)+1                ;  3 seconds in ticks
SEC_1         EQU     (18*1)+1                ;  1 second  in ticks
DSRWAIT       DW      SEC_30                  ; tics to wait for dsr
RETRIES       EQU     3                       ; number of retries
;       message structure
MSTX          EQU     0                       ; start of message
MCRC          EQU     MSTX+1                  ; CRC value
MLEN          EQU     MCRC+2                  ; length of remainder less etx
MBLKNO        EQU     MLEN+2                  ; number of this block
MCMD          EQU     MBLKNO+2                ; command
MDATA         EQU     MCMD+1                  ; data area
;                                             ; etx address based on data len
MOREAD        EQU     6                       ; overhead bytes not in len
;                                             ;    stx + crc + len + etx
;       DTA structure for DOS "find matching" call
DTA           EQU     80H                     ; dta offset
DTA_ATTR      EQU     BYTE PTR DTA+21         ; file attribute
DTA_TIME      EQU     WORD PTR DTA_ATTR+1     ; file time
DTA_DATE      EQU     WORD PTR DTA_TIME+2     ; file date
DTA_LSIZ      EQU     WORD PTR DTA_DATE+2     ; file lsw of size
DTA_HSIZ      EQU     WORD PTR DTA_LSIZ+2     ; file msw of size
DTA_NAME      EQU     BYTE PTR DTA_HSIZ+2     ; file name of file
DTA_LEN       EQU     DTA_NAME+15-DTA         ; length of dta find entry
;       messages to user
PARMERR       DB    "Usage: ZCOPY source [target] [/w][/u][/o][/a][/p][/d]"
              DB    13,10,"/w-wait",13,10,"/u-newer files only",13,10
              DB    "/o-overwrite",13,10,"/a-abort if target full",13,10
              DB    "/p-pause before copy",13,10,"/d-use current date",13,10,'$'
BADDIR        DB      "Invalid directory.",13,10,'$'
FILERR        DB      "No files specified.",13,10,'$'
FILEROPEN     DB      "Unable to create, skipping.",13,10,'$'
INVFIL        DB      "Invalid filename.",13,10,'$'
DISKFULL      DB      "Disk full .. press a key ..",13,10,'$'
SSENT         DB      " being sent.",13,10,'$'
SRECVD        DB      " being received.",13,10,'$'
TOOMANY       DB      "Resyncing ...",13,10,'$'
FILEXISTS     DB      ": exists. Overwrite?",13,10,'$'
TOOBIG        DB      ": won't fit, skipped.", 13, 10, '$'
WAITING       DB      "Press a key to continue ..",13,10,'$'
SHUTDOWN_R1   DB      13,10
SHUTDOWN_R    DB      "ZCOPY is done."
CRLF          DB      13,10,'$'
TRYING        DB      13,"Baud rate $"
SPDERROR      DB      13,10,"Link not established.",13,10,'$'
SPDSET        DB      13,10,"Link established.",13,10,'$'
NOTUP         DB      13,10,"Other node not detected.",13,10,'$'
              DB      '.....'
S_LEFT        DB      '.h blocks left.     ',13,'$'

BEGINNING     PROC    NEAR                    ; start of program
              MOV     DX,OFFSET COPYRIGHT
              MOV     AH,9
              INT     21H
              MOV     BX, OFFSET BUF_START    ; bx -> start of buffer space
              MOV     RBUF, BX                ; set offset of the receive buffer
              MOV     RBUF_RPTR, BX           ; .. for receive
              MOV     RBUF_GPTR, BX           ; .. and get
              ADD     BX, RBUFL               ; bx -> start of send buffer
              MOV     RBUF_HI, BX             ; .. save for int handler
              MOV     SBUF, BX                ; set offset of the send buffer
              ADD     BX, SBUFL               ; bx -> start of work buffer
              MOV     WBUF, BX                ; set offset of the work buffer
              ADD     BX, WBUFL               ; bx -> star to file build buffer
              MOV     XBUF, BX                ; set pointer to buffer
              MOV     XBUF_PTR, BX            ; .. and write pointer
              ADD     BX, XBUFL               ; bx -> entry directory area
              MOV     EDIR, BX                ; .. save pointer
              MOV     AH, 19H                 ; ah = get current drive
              INT     21H                     ; al = current drive
              MOV     EDRV, AL                ; save entry drive
              MOV     SI, SDIR                ; si -> current directory area
              MOV     BYTE PTR [SI], '\'      ; .. start with backslash
              INC     SI                      ; si -> next byte
              XOR     DL, DL                  ; dl = default drive
              MOV     AH, 47H                 ; ah = get current dir
              INT     21H                     ; .. save in area
              CALL    ZCPARM                  ; set up parameters
              CALL    ZCINIT                  ; init interrupts
              CALL    ZCSPEED                 ; setup transfer speed
              TEST    FLG, FLGR               ; Q. receiver?
              JNZ     MAINRCV                 ; A. yes .. rcv
              MOV     AL, SET_FLG             ; al = set flags command
              MOV     SI, OFFSET FLG          ; si -> flags byte
              MOV     CX, 1                   ; .. len to send
              CALL    ZCBLKSND                ; .. send set flags
              MOV     BX, WAIT_COUNT          ; bx = wait_count
              ADD     BX, SEC_10              ; .. max 10 secs
MAIN10:       CALL    ZCTRYRCV                ; Q. block available?
              JNC     MAIN15                  ; A. yes .. continue
              CMP     WAIT_COUNT, BX          ; Q. timeout?
              JB      MAIN10                  ; A. no .. continue
              MOV     DX, OFFSET NOTUP        ; dx -> error message
              CALL    ZCDIE                   ; .. die of old age
MAIN15:       OR      FLG, AL                 ; save flags
              TEST    FLG, FLGP               ; Q. pause before starting?
              JZ      MAIN20                  ; A. no .. wait
              MOV     DI, OFFSET WAITING      ; di -> waiting prompt
              CALL    ZCSPROMPT               ; .. wait for response
MAIN20:       JMP     ZCSF                    ; send the files requested
MAINRCV:      CALL    ZCRECV                  ; start receive mode
              JMP     MAINRCV                 ; .. continuously
BEGINNING     ENDP
; -----------------------------------------------------------------
;       This routine initializes the system interrupts.
; -----------------------------------------------------------------
ZCINIT        PROC    NEAR
              MOV     DX, IO_BASE             ; dx = base io port
              IN      AL, DX                  ; .. clear any character
              INC     DX                      ; dx = ier
              XOR     AL, AL                  ; al = zero
              OUT     DX, AL                  ; no ints for now
              ADD     DX, 3                   ; dx = mcr
              OUT     DX, AL                  ; .. set off all stats
              ADD     DX, 2                   ; dx = msr
              IN      AL, DX                  ; .. reset msr now
              MOV     AL, INT_VECTOR          ; al = com interupt to set
              ADD     AL, 8                   ; .. set to actual interrupt
              MOV     SI, OFFSET OLD_COM      ; si -> save area for old
              MOV     DX, OFFSET ZCINT        ; dx -> com int routine
              CALL    ZCSETINT                ; set up the interrupt
              MOV     AL, 08H                 ; al = timer interrupt to set
              MOV     SI, OFFSET OLD_TIMER    ; si -> save area for old
              MOV     DX, OFFSET ZCTIMER      ; dx -> timer int routine
```

(continues)

ZCOPY.ASM: *The source code for ZCOPY.COM. Use a macro assembler to assemble it, then link, and then EXE2BIN it to create the .COM file.*

■ UTILITIES

```
            CALL    ZCSETIHT                ; aet up the interrupt
            MOV     AL, 1BN                 ; al = control break interrupt
            MOV     SI, OFFSET OLD_CTLBRR   ; si -> save area for old
            MOV     DX, OFPSET ZCCTLBRR     ; dx -> timer int routine
            CALL    ZCSETINT                ; set up the interrupt
            MOV     AL, 23N                 ; el = control breek interrupt
            MOV     SI, OFFSET OLD_DOSCTLB  ; si -> save area for old
            MOV     DX, OFPSET ZCCTLBRR     ; dx -> timer int routine
            CALL    ZCSETIMT                ; set up the interrupt
            MOV     AL, 24H                 ; ax = doserr interrupt to set
            MOV     SI, OFPSET OLD_DOSERR   ; si -> save area for old
            MOV     DX, OFFSET ZCDOSERR     ; dx -> dos error routine
            CALL    ZCSETINT                ; set up the interrupt
            MOV     DX, IO_SASE             ; dx -> base of com port
            ADD     DX, 2                   ; dx -> Int id register
            HOV     ZCIHTIIR1, DX           ; modify int rtn instruction
            HOV     ZCINTIIR2, DX           ; modify int rtn inatruction
            INC     DX                      ; dx -> line control reg
            MOV     AL, LCR_SETUP           ; al = com parm aetup
            OUT     DX, AL                  ; .. set line characteristics
            IHC     DX                      ; dx -> modem control reg
            MOV     AL, MCR_OUT2            ; al = aet on OUT2
            OUT     DX, AL                  ; .. set MCR value
            SUS     DX, 3                   ; dx -> interrupt eneble reg
            MOV     AL, 05H                 ; al = allow lsr & rx ints
            OUT     DX, AL                  ; .. set int eneble register
            IH      AL, 21H                 ; al = current int mask
            MOV     CL, IHT_VECTOR          ; cl = interrupt to use
            MOV     AN, 1                   ; ah = 1 ..
            SHL     AN, CL                  ; .. shift bit to mask pos
            NOT     AM                      ; .. and invert maak
            AND     AL, AN                  ; .. set off mask bit
            OUT     21H, AL                 ; .. allow com interrupts
            OR      FLG1, FLG1I             ; show initialized
            MOV     AL, INT_VECTOR          ; al = int vector
            DEC     AL                      ; al -> lower vector
            OR      AL, 0C0N                ; al = set 0259 priority cmd
            OUT     20H, AL                 ; .. reset priority
            RET                             ; .. return to caller
ZCINIT      EHDF
; ----------------------------------------------------------------
;       This routine resets ths syatem to pre-runtime settings.
; ----------------------------------------------------------------
ZCRESET     PROC    NEAR
            MOV     AL, 0C7H                ; al = set priority command
            OUT     20N, AL                 ; reset normal 0259 priority
            TEST    FLG1, FLG1O             ; Q. file open?
            JZ      ZCRESET10               ; A. no .. continue
            MOV     0X, NAHDLE              ; bx = file handle
            MOV     AH, 3EH                 ; ah = close
            INT     21H                     ; .. close that file
ZCRESET10:  HOV     CL, INT_VECTOR          ; cl = interrupt to use
            IN      AL, 21H                 ; el = current int mask
            MOV     AN, 1                   ; ah = 1 ..
            SHL     AN, CL                  ; .. ahift bit to mask pos
            OR      AL, AN                  ; .. set on msak bit
            OUT     21H, AL                 ; .. disallow com interrupts
            MOV     DX, IO_BASE             ; dx -> base of com port
            INC     DX                      ; dx -> interrupt enable reg
            XOR     AL, AL                  ; al = ell interrupts off
            OUT     DX, AL                  ; .. disellow all interrupts
            ADD     DX, 3                   ; dx -> modem control reg
            OUT     DX, AL                  ; .. aet OUT2 & DTR off
            MOV     AL, IHT_VECTOR          ; al = com interupt to reset
            ADD     AL, 8                   ; .. set to actual interrupt
            MOV     SI, OPFSET OLD_COM      ; si -> aave area for old
            CALL    ZCRESINT                ; reset the interrupt
            MOV     AL, 1BN                 ; al = ctlbreak interrupt
            MOV     SI, OFFSET OLD_CTLBNX   ; si -> save area for old
            CALL    ZCRESIMT                ; reset the interrupt
            MOV     AL, 23N                 ; al = ctlbreak interrupt
            HOV     SI, OFFSET OLD_DOSCTLS  ; si -> aave area for old
            CALL    ZCRESINT                ; reset the interrupt
            MOV     AL, 08N                 ; al = timer interrupt to reset
            MOV     SI, OFFSET OLD_TIMER    ; ai -> save area for old
            CALL    ZCRESINT                ; reset the interrupt
            CALL    ZCTIMUP                 ; assure timer fully reset
            MOV     AL, 24N                 ; ax = doserr interrupt to reset
            MOV     SI, OFFSET OLD_DOSERR   ; ai -> aave area for old
            CALL    ZCRESINT                ; reset the interrupt
            RET                             ; .. return to caller
ZCRESET     ENDP
; ----------------------------------------------------------------
; This routine initializes an interrupt vector.
; Entry:al = interrupt to setup,ai -> save area for old,dx -> routine to call
; ----------------------------------------------------------------
ZCSETIHT    FROC    HEAR
            PUSH    SX                      ; aave caller's bx
            PUSN    ES                      ; .. and es
            MOV     AH, 35H                 ; ah = get int vector
            INT     21H                     ; es:bx -> current vector
            MOV     WORD PTR [SI], SX       ; save offset
            MOV     WORD PTR [SI+2], ES     ; .. and segment
            MOV     AH, 25H                 ; eh = set int vector
            IHT     21H                     ; .. set up the interrupt
            POP     ES                      ; reatore rega
            POF     0X
            RET                             ; .. return to caller
ZCSETINT    ENDP
; ----------------------------------------------------------------
; This routine reatores the original interrupt vector.
; Entry:al = interrupt to setup,si -> save area for old
; ----------------------------------------------------------------
ZCRESINT    PROC    NEAR
            PUSN    DS                      ; save da
            PUSH    DX                      ; .. and dx
            LDS     DX, [SI]                ; da:dx -> original vector
            HOV     AN, 25N                 ; ah = set int vector
            INT     21H                     ; .. set up the interrupt
            POF     DX                      ; reatore rega
            POF     DS
            RET                             ; .. return to celler
ZCRES:NT    ENDP
; ----------------------------------------------------------------
; This routine intercepts control-breaks and handles them gracefully.
; ----------------------------------------------------------------
ZCCTLBRK    PROC    HEAR
            OR      CS:FLG1, FLG1B          ; show break issued
            IRET                            ; return to caller
ZCCTLBRR    ENDF
; ----------------------------------------------------------------
; This routine increments e locel timer varieble when called.
; ----------------------------------------------------------------
ZCTIMER     FROC    REAR
            STI                             ; ellow iots
            PUSN    AX                      ; save ax
            MOV     AL, 20N                 ; el = reset interrupt
            OUT     20H, AL                 ; .. reset it
            POF     AX                      ; restore ax
            INC     CS:WAIT_COUNT           ; increment # ticks
            INC     CS:TIME_COUNT           ; .. and timer ticks
            IRET                            ; return from interrupt
ZCTIMER     ENDP
; ----------------------------------------------------------------
; Thia routine updstes the system timer.
; ----------------------------------------------------------------
ZCTIMUF     FROC    MEAR
            OR      TIME_COUNT, 0           ; Q. any update?
            JZ      ZCTIMUP90               ; A. no .. return
            PUSN    D0                      ; aave ds
            MOV     AX, 40H                 ; ax -> bios low memory seg
            MOV     DS, AX                  ; da -> bios low memory seg
            XOR     AX, AX                  ; ax = sero
            XCHG    AX, CS:TIME_COUNT       ; ax = ticks since update
            ADD     DS:[TIMER_LOW], AX      ; .. add to timer value
            ADC     DS:[TIMER_HI], 0        ; .. end the overflow
            POF     DS                      ; restore ds
ZCTIMUP90:  RET
ZCTIMUF     ENDF
; ----------------------------------------------------------------
; This routine intercepts and bandles DOS critical errors.
; Entry: Standsrd INT 24h entry; Exit: Only ellows retries and aborts.
; ----------------------------------------------------------------
ZCDOSERR    PROC    HEAR
            FUSNF                           ; save the flegs
            AND     AH, HOT 20N             ; ellow retry, abort ooly
            CALL    CS:OLD_DOSERR           ; .. call old routine
            CMP     AL, 1                   ; Q. retry?
            JE      ZCDOSERR90              ; A. yes .. contioue
            OR      CS:FLG1, FLG1S          ; turn on die flag
            MOV     AL, 0                   ; .. and ignore error
ZCDOSERR90: IRET
ZCDOSERR    ENDP
; ----------------------------------------------------------------
; Communications interrupt handler. Handled from the com port
;       specified by the user on the command line.
; ----------------------------------------------------------------
ZCINT       PROC    HEAR                    ; ioterrupt hendler entry point
            FUSH    AX                      ; seve entry registers
            FUSH    BX                      ; ...
            PUSN    DX                      ;   ...
            MOV     AL, EOI                 ; al = EOI instruction
            OUT     I0259, AL               ; .. reset tbe 0259
ZCINT05:    MOV     DX, 0FFFFH              ; dx = int ID register addr
ZCINTIIR1   EQU     WORD PTR ZCINT05+1      ; .. address to mod for iir
            IN      AL, DX                  ; al = int id
            JMP     SHORT ZCINT17           ; .. process ioterrupt
ZCINT10:    MOV     DX, 0FFFFH              ; dx = int ID register addr
ZCINTIIR2   EQU     WORD PTR ZCIMT10+1      ; .. addreaa to mod for iir
ZCINT15:    IH      AL, DX                  ; al = interrupt ID
            TEST    AL, 00000001B           ; Q. eny ioterrupt?
            JNZ     ZCINT90                 ; A. no .. exit oow.
ZCINT17:    CMP     AL, 4                   ; Q. received dete int?
            JNE     ZCINT50                 ; A. no .. process stet regs
            SUB     DX, 2                   ; dx = bese reg
            IN      AL, DX                  ; el = next receive character
ZCINT_RPTR: MOV     BX, 0P1F2H              ; bx -> receive buffer
            MOV     CS:[SX], AL             ; .. seve received character
            INC     SX                      ; bx -> next receive char pos
ZCINT_RHI:  CMP     BX, 0P1P2N              ; Q. end of receive buffer?
            JNB     ZCINT_RBUP              ; A. yes .. set to rbuf
ZCINT20:    MOV     CS:RBUF_RPTR, BX        ; save receive pointer
            JMP     ZCINT10                 ; see if enotber int occurred
ZCINT_RBUF: MOV     SX, 0P1P2N              ; bx -> stert of buffer
            JMP     ZCINT20                 ; .. end continue
ZCINT50:    ADD     DX, 3                   ; dx -> lsr
            IH      AL, DX                  ; .. get value
            MOV     CS:LSR_VAL, AL          ; seve lsr value
            MOV     CS:LSR_HEW, 0PPN        ; .. ahow value ia new
            SUB     DX, 3                   ; dx -> int ID reg
            JMP     ZCINT15                 ; See if done
ZCINT90:    STI                             ; allow interrupt
            POP     DX                      ; Restore entry registers
            POF     SX                      ;    ...
            POF     AX                      ;     ...
            IRET                            ; return from interrupt
RBUP_RPTR   EQU     WORD PTR ZCINT_RPTR+1   ; rptr word
RBUP        EQU     WORD PTR ZCINT_RBUF+1   ; rbuf word
RBUF_HI     EQU     WORD PTR ZCINT_RHI+2    ; hi word
ZCINT       EHDF
; ----------------------------------------------------------------
; This routine sends the requested character.
; Entry: al = character to send
; ----------------------------------------------------------------
ZCPUTC      PROC    NEAR
            FUSH    BX                      ; save registers
            PUSH    CX
            PUSN    DX
            FUSH    SI
            PUSH    AX
            MOV     DX, IO_BASE             ; dx -> base io address
            ADD     DX, LSR                 ; dx = line status addr
ZCPUTC10:   IM      AL, DX                  ; al = lsr
            AND     AL, LSR_TRRE            ; leeve tsre & thre on
            CMP     AL, LSR_THRE            ; Q. all empty?
            JNE     ZCPUTC10                ; A. no .. retry
            POF     AX                      ; get character
            MOV     DX, IO_BASE             ; .. snd base register
            OUT     DX, AL                  ; .. put the cbar
            POP     SI                      ; restore registers
```

(ZCOPY.ASM continues)

```
               POP     DX
               POP     CX
               POP     BX
               RET                             ; ..and return to caller
ZCPUTC         ENDP
; ----------------------------------------------------------------------
; This routine gets a character from the receive buffer if one is available.
; Exit: al = character; carry flag set indicates no character available
; ----------------------------------------------------------------------
ZCGETC         PROC    NEAR                    ; get a received char, if any
               CALL    ZCCLA                   ; Q. anything to get?
               JNC     ZCGETC00                ; A. yes .. update pointers
               RET                             ; .. else .. return to caller
ZCGETC00:      PUSH    BX                      ; save caller's bx
               MOV     BX, RBUF_GPTR           ; bx = next get pointer
               INC     BX                      ; bx -> next position
               CMP     BX, RBUF_HI             ; Q. end of buffer?
               JB      ZCGETC90                ; A. no .. store as it
               MOV     BX, RBUF                ; bx -> start of buffer
ZCGETC90:      MOV     RBUF_GPTR, BX           ; save get pointer
               POP     BX                      ; restore caller's bx
               CLC                             ; .. show char available
               RET                             ; return to caller
ZCGETC         ENDP
; ----------------------------------------------------------------------
; This routine reads one character from the receive buffer
; without adjusting the read buffer pointers.
; Exit: al = character; carry flag set indicates no character available
; ----------------------------------------------------------------------
ZCCLA          PROC    NEAR
               PUSH    BX                      ; save registers
               MOV     BX, RBUF_GPTR           ; bx = next get offset
               CMP     BX, RBUF_RPTR           ; Q. anything to get?
               JNE     ZCCLA10                 ; A. yes .. continue
               STC                             ; show no char found
               JMP     SHORT ZCCLA90           ; .. and return to caller
ZCCLA10:       MOV     AL, [BX]                ; al = char
               CLC                             ; .. set carry to char found
ZCCLA90:       POP     BX                      ; restore registers
               RET                             ; .. and return to caller
ZCCLA          ENDP
; ----------------------------------------------------------------------
; This routine parses the command line.
; Exit: Returns to DOS if error else argument bits and values are set.
; ----------------------------------------------------------------------
ZCPARM         PROC    NEAR
               CALL    ZCUC                    ; upper case the parm area
               MOV     SI, 81H                 ; si -> parms area
ZCPARM10:      CALL    ZCPARMC                 ; get parameter character
               CMP     AL, '/'                 ; Q. option?
               JE      ZCPARM80                ; A. yes .. check option
               CMP     AL, 13                  ; Q. end of line?
               JE      ZCPARM50                ; A. yes .. exit
               CMP     AL, ' '                 ; Q. blank?
               JNA     ZCPARM10                ; A. yes .. skip
               CALL    ZCARG                   ; set the argument
               JC      ZCPARMERR               ; .. die on an error
ZCPARM30:      CALL    ZCPARMC                 ; get next character
               CMP     AL, 13                  ; Q. end of line?
               JE      ZCPARM50                ; A. yes .. process
               CMP     AL, '/'                 ; Q. start of option?
               JE      ZCPARM80                ; A. yes .. process
               CMP     AL, ' '                 ; Q. end of parm?
               JA      ZCPARM30                ; A. no .. next char
               MOV     BYTE PTR [SI-1], 0      ; end the parm
               JMP     ZCPARM10                ; .. look for next
ZCPARM50:      MOV     BYTE PTR [SI-1], 0      ; zero out the <cr>
               CMP     ARG1, 0                 ; Q. parm 1 available?
               JE      ZCPARMERR               ; A. no .. error
               CMP     ARG2, 0                 ; Q. Parm 2 available?
               JNE     ZCPARM60                ; A. yes .. continue
               MOV     ARG2, OFFSET DFLDIR     ; set up for current directory
ZCPARM60:      CALL    ZCCOM                   ; check the com parameter
               CALL    ZCFLSET                 ; set up file parameters
               RET                             ; return to caller
ZCPARM80:      MOV     BYTE PTR [SI-1], 0      ; end the parm
               CALL    ZCPARMC                 ; al = option character
               CMP     AL, '1'                 ; Q. < 1?
               JB      ZCPARM82                ; A. yes .. continue
               CMP     AL, '6'                 ; Q. > 6?
               JA      ZCPARM82                ; A. yes .. continue
               SUB     AL, '1'                 ; .. adjust the value
               MOV     BAUD_CNTR, AL           ; .. save as starting baud
               JMP     ZCPARM10                ; .. continue
ZCPARM82:      LEA     DI, PARM_TBL            ; di -> table to search
               MOV     CX, 6                   ; cx = max entries
     REPNE     SCASB                           ; Q. entry found?
               JNE     ZCPARMERR               ; A. no .. parameter in error
               MOV     AL, 1                   ; al - amount to shift
               SHL     AL, CL                  ; .. do it
               OR      FLG, AL                 ; .. or in the flag
               JMP     ZCPARM10                ; .. continue scanning
ZCPARMERR:     LEA     DX, PARMERR             ; dx -> invalid number of parms
               CALL    ZCDIE                   ; abort
ZCPARM         ENDP
; ----------------------------------------------------------------------
; This routine gets the next character from the parm area in the DOS PSP.
; Entry: si -> next char to get.
; Exit: Char translated to upper case. al = character; si -> next character
; ----------------------------------------------------------------------
ZCPARMC        PROC    NEAR
               CMP     BYTE PTR [SI], 'a'      ; Q. below lower case a?
               JB      ZCPARMC10               ; A. yes .. do not upcase
               CMP     BYTE PTR [SI], 'x'      ; Q. above lower case ?'
               JA      ZCPARMC10               ; A. yes .. same
               AND     BYTE PTR [SI], NOT 20H  ; .. translate to upper case
ZCPARMC10:     LODSB                           ; load the character in AL
               RET                             ; .. and return to caller
ZCPARMC        ENDP
; ----------------------------------------------------------------------
; This routine sets the appropriate argument pointer.
; Entry: si -> second character in argument.
; Exit: arg1 or arg2 pointer filled in. Carry set if more than 2 arguments
; ----------------------------------------------------------------------
ZCARG          PROC    NEAR
               LEA     BX, [SI-1]              ; bx -> argument
```

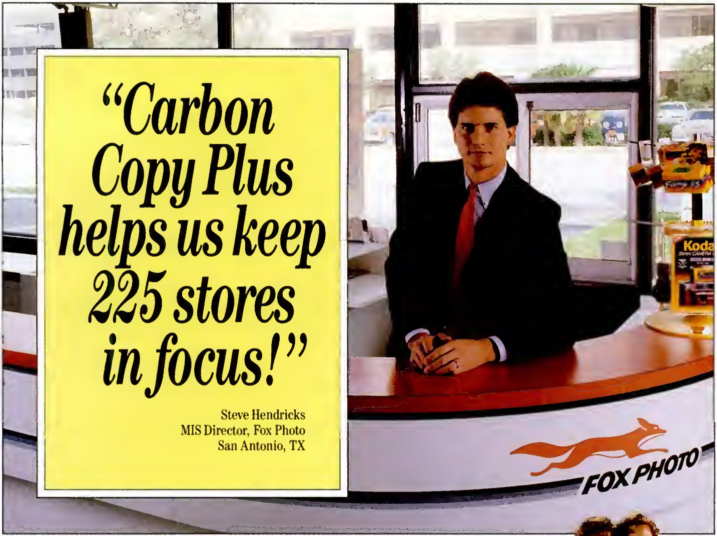
```
               CMP     ARG1, 0                 ; Q. arg1 filled in?
               JNE     ZCARG10                 ; A. yes .. check 2
               MOV     ARG1, BX                ; save arg1 pointer
               JMP     SHORT ZCARG90           ; .. exit ok!
ZCARG10:       CMP     ARG2, 0                 ; Q. arg2 filled in?
               JE      ZCARG20                 ; A. no .. fill it in
               STC                             ; else .. error
               RET                             ; .. and return to caller
ZCARG20:       MOV     ARG2, BX                ; save arg2 pointer
ZCARG90:       CLC                             ; show no error
               RET                             ; return to caller
ZCARG          ENDP
; ----------------------------------------------------------------------
; This routine determines whether we are the sender or receiver
; and which communication port is to be used.
; Entry: ARG1, ARG2 must be set, one pointing to COMx with an optional colon
; Exit: Send/receive flag is set properly. IO_BASE and INT_VECTOR are set.
;       Exits to DOS if no COM port or 2 COM ports specified.
; ----------------------------------------------------------------------
ZCCOM          PROC    NEAR
               MOV     SI, ARG1                ; si -> parm1
               CALL    ZCCOMP                  ; Q. receiver?
               JC      ZCCOM10                 ; A. no .. check parm2
               OR      FLG, FLGR               ; else .. set receiver mode
ZCCOM10:       MOV     BL, FLG                 ; bx = flags
               MOV     SI, ARG2                ; si -> parm2
               CALL    ZCCOMP                  ; Q. sender?
               JC      ZCCOM20                 ; A. no .. assure receiver
               TEST    BL, FLGR                ; Q. Are we receiver?
               JZ      ZCCOM80                 ; A. No .. parms ok
ZCCOM15:       LEA     DX, PARMERR             ; dx -> parameter error
               CALL    ZCDIE                   ; .. die gracefully
ZCCOM20:       TEST    BL, FLGR                ; Q. Are we a receiver?
               JZ      ZCCOM15                 ; A. no .. issue error
ZCCOM80:       CMP     AL, 1                   ; Q. COM1?
               JNE     ZCCOM85                 ; A. no .. set up for COM2.
               MOV     IO_BASE, 3F8H           ; set base port address
               MOV     INT_VECTOR, 4           ; .. and interrupt number
               RET                             ; return to caller
ZCCOM85:       MOV     IO_BASE, 2F8H           ; set base port address
               MOV     INT_VECTOR, 3           ; .. and interrupt number
               RET                             ; return to caller
ZCCOM          ENDP
; ----------------------------------------------------------------------
; This routine looks for a valid COMx: in the passed parameter.
; Entry: si -> string to check
; Exit: Carry set if not COMx: string; al = 1 or 2 for COM1: or COM2:
; ----------------------------------------------------------------------
ZCCOMP         PROC    NEAR
               PUSH    BX                      ; save bx
               MOV     BX, SI                  ; bx -> argument
               CLD                             ; set direction
               LEA     DI, COM_STR             ; di -> 'COM'
               MOV     CX, 3                   ; cx = length of string
     REPE      CMPSB                           ; Q. 'COM' start the string?
               JE      ZCCOMP10                ; A. yes.. continue
ZCCOMP05:      STC                             ; show not a com port
               POP     BX                      ; restore bx
               RET                             ; .. return to caller
ZCCOMP10:      CMP     BYTE PTR [BX+4], ':'    ; Q. end in colon?
               JE      ZCCOMP30                ; A. yes .. check which port
               CMP     BYTE PTR [BX+4], 0      ; Q. non-colon end?
               JNE     ZCCOMP05                ; A. no .. not a com parameter
ZCCOMP30:      MOV     AL, [BX+3]              ; ah = ascii com port number.
               SUB     AL, 30H                 ; ah = binary com port number.
               CMP     AL, 1                   ; Q. below COM1?
               JB      ZCCOMP05                ; A. yes .. invalid com port
               CMP     AL, 2                   ; Q. above com2?
               JA      ZCCOMP05                ; A. yes .. invalid com port
               CLC                             ; else .. good com port
               POP     BX                      ; restore bx
               RET                             ; .. return to caller
ZCCOMP         ENDP
; ----------------------------------------------------------------------
; This routine displays an error message and terminates.
; Entry: dx -> error message ended in dollar sign.
; Exit: Exits to DOS
; ----------------------------------------------------------------------
ZCDIE          PROC    NEAR
               TEST    FLG1, FLG1I             ; Q. initialized?
               JZ      ZCDIE10                 ; A. no .. print & return
               PUSH    DX                      ; else .. save message address
               CALL    ZCRESET                 ; .. reset system
               POP     DX                      ; .. restore message address
ZCDIE10:       MOV     AH, 9                   ; ah = print string
               INT     21H                     ; .. call dos to print error
               MOV     AX, 4C01H               ; ax = exit
               INT     21H                     ; .. terminate routine
ZCDIE          ENDP
; ----------------------------------------------------------------------
; This routine changes all arguments on the command line to upper case
; ----------------------------------------------------------------------
ZCUC           PROC    NEAR
               PUSH    SI                      ; save caller regs
               PUSH    DI
               MOV     SI, 81H                 ; si -> start of parm area
               MOV     DI, SI                  ; .. same for di
ZCUC10:        LODSB                           ; al = char
               CMP     AL, 13                  ; Q. end of line?
               JE      ZCUC90                  ; A. yes .. end of line!
               CMP     AL, 'a'                 ; Q. is it below 'a'?
               JB      ZCUC20                  ; A. yes .. continue
               CMP     AL, 'z'                 ; Q. is it above 'x'?
               JA      ZCUC20                  ; A. yes .. continue
               SUB     AL, 20H                 ; set to upper case
ZCUC20:        STOSB                           ; save the byte
               JMP     ZCUC10                  ; .. and continue
ZCUC90:        POP     DI                      ; restore caller regs
               POP     SI
               RET                             ; .. and return to caller
ZCUC           ENDP
; ----------------------------------------------------------------------
; This routine sets the default drive and path.
; On the sending machine, the file name is also set up.
; ----------------------------------------------------------------------
```

(ZCOPY.ASM continues)

■ UTILITIES

```
ZCFLSET     PROC    NEAR
            MOV     DI, ARG1                ; di -> first arg
            TEST    FLG, FLGR               ; Q. receiver?
            JZ      ZCFLSET10               ; A. no .. continue
            MOV     DI, ARG2                ; di -> second arg
ZCFLSET10:  CMP     BYTE PTR [DI+1], ':'    ; Q. drive specified?
            JNE     ZCFLSET20               ; A. no .. use current drive
            MOV     DL, [DI]                ; dl = drive to use
            SUB     DL, 'A'                 ; get requested drive number
            MOV     AH, 0EH                 ; set requested drive
            INT     21H                     ; .. via dos
            ADD     DI, 2                   ; di -> next part
ZCFLSET20:  TEST    FLG, FLGR               ; Q. receiver?
            JNZ     ZCFLSET50               ; A. yes .. filename not used
            PUSH    DI                      ; save pointer
            MOV     BX, DI                  ; bx -> start of area
            XOR     AL, AL                  ; al = search for null
            MOV     CX, 128                 ; very max to search
            CLD
    REPNE   SCASB                           ; find end of arg
            LEA     SI, [DI-1]              ; si -> nul
            MOV     CX, 0                   ; cx = 0 chars to move
            CMP     SI, BX                  ; Q. any file name
            JE      ZCFLSET80               ; A. no .. error
ZCFLSET30:  DEC     SI                      ; si -> prev char
            CMP     BYTE PTR [SI], '\'      ; Q. dir?
            JE      ZCFLSET35               ; A. yes .. end of file name.
            INC     CX                      ; cx = char count
            CMP     SI, BX                  ; Q. done?
            JB      ZCFLSET37               ; A. yes .. move file name
            JMP     ZCFLSET30               ; .. continue
ZCFLSET35:  INC     SI                      ; si -> start of file name
ZCFLSET37:  OR      CX, CX                  ; Q. file name spec'd?
            JZ      ZCFLSET80               ; A. no .. error
            CMP     CX, 12                  ; Q. too long?
            JA      ZCFLSET85               ; A. yes .. error
            PUSH    SI                      ; save start pointer
            MOV     DI, OFFSET FILENAME     ; di -> file name
     REP    MOVSB                           ; .. move in the file name
            POP     SI                      ; restore start pointer
            POP     DI                      ; .. and dir pointer
            CMP     SI, BX                  ; Q. at start of parm?
            JB      ZCFLSET90               ; A. yes .. return
            INC     BX                      ; bx -> next char
            CMP     SI, BX                  ; Q. root only given?
            JE      ZCFLSET40               ; A. yes .. continue
            DEC     SI                      ; si -> last \
ZCFLSET40:  MOV     BYTE PTR [SI], 0        ; make dir ASCIIZ
ZCFLSET50:  MOV     DX, DI                  ; dx -> directory
            MOV     AH, 3BH                 ; ah = CHDIR opcode
            INT     21H                     ; .. change directory
            JNC     ZCFLSET90               ; if ok .. continue
            MOV     DX, OFFSET BADDIR       ; dx -> baddir request
            CALL    ZCDIE                   ; .. die now
ZCFLSET80:  MOV     DX, OFFSET FILERR       ; dx -> no file specified
            CALL    ZCDIE
ZCFLSET85:  MOV     DX, OFFSET INVFIL       ; dx -> invalid filename spec'd
            CALL    ZCDIE
ZCFLSET90:  RET                             ; return to caller
ZCFLSET     ENDP
; ---------------------------------------------------------------------
; This routine waits for n nbr of timer ticks to transpire.
; Entry: ax = nbr of timer ticks to wait
; ---------------------------------------------------------------------
ZCWAIT      PROC    NEAR
            ADD     AX, WAIT_COUNT          ; ax = count to wait till
ZCWAIT10:   CMP     WAIT_COUNT, AX          ; Q. enough time elapsed?
            JNA     ZCWAIT10                ; A. no .. loop
            CALL    ZCTIMUP                 ; .. update system timer
            RET                             ; finally, return to caller
ZCWAIT      ENDP
; ---------------------------------------------------------------------
; This routine retrieves the most recent LSR value.
; Exit: carry set if new value is found.; al = last LSR value detected.
; ---------------------------------------------------------------------
ZCLSRGET    PROC    NEAR
            CLI                             ; no interrupts
            MOV     AL, LSR_VAL             ; al = last known LSR value
            OR      LSR_NEW, 0              ; check if value is new
            MOV     LSR_NEW, 0              ; .. reset it
            STI                             ; .. allow interrupts
            JNZ     ZCLSRGET90              ; .. jump if new value
            CLC                             ; show no new value
            RET                             ; .. and return to caller
ZCLSRGET90: STC                             ; show new value
            RET                             ; .. and return to caller
ZCLSRGET    ENDP
; ---------------------------------------------------------------------
; This routine sends a break .2 seconds long.
; ---------------------------------------------------------------------
ZCBREAK     PROC    NEAR
            PUSH    AX                      ; save caller regs
            PUSH    BX
            PUSH    DX
            MOV     DX, IO_BASE             ; dx -> comm base register
            ADD     DX, 3                   ; dx = line control reg addr
            IN      AL, DX                  ; al = LCR contents
            MOV     BL, AL                  ; bl = LCR
            OR      AL, 40H                 ; .. turn on break bit
            OUT     DX, AL                  ; .. send a break
            MOV     AX, 4                   ; wait 4 ticks (~ .2 secs)
            CALL    ZCWAIT                  ; .. wait ...
            AND     AL,NOT 40H              ; assure no break bit
            MOV     AL,BL                   ; al = old LSR contents
            OUT     DX, AL                  ; end the break
            POP     DX                      ; restore registers
            POP     BX
            POP     AX
            RET                             ; return to caller
ZCBREAK     ENDP
; ---------------------------------------------------------------------
; This routine clears the incomming buffer by resetting the buffer pointers.
; ---------------------------------------------------------------------
ZCCLRCOM    PROC    NEAR
            PUSH    RBUF_RPTR               ; push the receive pointer
            POP     RBUF_GPTR               ; .. and pop get pointer
            RET                             ; .. and return to caller
ZCCLRCOM    ENDP
; ---------------------------------------------------------------------
; This routine tests if a break was recently detected.
; Exit: returns NZ if break found, zero if not.
; ---------------------------------------------------------------------
ZCTSTBRK    PROC    NEAR
            PUSH    AX                      ; save caller registers
            CALL    ZCLSRGET                ; get LSR value
            JC      ZCTSTBRK80              ; .. test value if found
            SUB     AH, AH                  ; assure zero flag set
            JMP     SHORT ZCTSTBRK90        ; .. return to caller
ZCTSTBRK80: TEST    AL, LSR_BRK             ; Q. BREAK occur?
ZCTSTBRK90: POP     AX                      ; restore ax
            RET                             ; return to caller
ZCTSTBRK    ENDP
; ---------------------------------------------------------------------
; This routine will setup the baud rate for the com port.
; Entry: ax = baud rate index
; 0=115.2kb, 1=57.6kb, 2=38.4kb, 3=19.2kb, 4=9600, 5=4800
; ---------------------------------------------------------------------
ZCBAUD      PROC    NEAR
            PUSH    AX                      ; save registers
            PUSH    BX
            PUSH    DX
            PUSH    AX                      ; save ax
            MOV     DX, OFFSET TRYING       ; dx -> baud message
            MOV     AH, 9                   ; ah = print "$" message
            INT     21H                     ; .. tell 'em what we're doing
            POP     AX                      ; restore baud request
            MOV     BX, AX                  ; bx = baud index
            MOV     CL, 3                   ; .. shift for * 8
            SHL     BX, CL                  ; bx = baud index * 8
            SUB     BX, AX                  ; .. make that * 7
            LEA     DX, BAUD_TABLE+1[BX]    ; dx -> $ message
            MOV     BL, BAUD_TABLE[BX]      ; bl = divisor
            XOR     BH, BH                  ; .. upper byte off
            MOV     AH, 9H                  ; ah = print '$' message
            INT     21H                     ; .. display baud rate
            TEST    FLG1, FLG1B             ; Q. ctl-break?
            JZ      ZCBAUD10                ; A. no .. continue
            MOV     DX, OFFSET SHUTDOWN_S1  ; dx -> shutdown msg
            CALL    ZCDIE                   ; .. end it all
ZCBAUD10:   MOV     DX, IO_BASE             ; dx = io port base addr
            ADD     DX, 3                   ; dx = line control register
            IN      AL, DX                  ; al = lcr
            OR      AL, LCR_DLAB            ; al = divisor latch enable
            CLI                             ; stop interrupts, then ..
            OUT     DX, AL                  ; enable the setting of the dlab
            SUB     DX, 3                   ; dx = LSB port of divisor latch
            MOV     AL, BL                  ; al = LSB of new divisor
            OUT     DX, AL                  ; output the LSB portion
            INC     DX                      ; dx = MSB port of divisor latch
            MOV     AL, BH                  ; al = MSB of new divisor
            OUT     DX, AL                  ; output the MSB portion
            ADD     DX, 2                   ; dx = line control register
            IN      AL, DX                  ; al = lcr
            AND     AL, NOT LCR_DLAB        ; .. set off dlab
            OUT     DX, AL                  ; .. restore line control register
            STI                             ; .. and re-enable interrupts
            POP     DX                      ; restore caller's registers
            POP     BX
            POP     AX
            RET                             ; ..and return to caller
ZCBAUD      ENDP
; ---------------------------------------------------------------------
; This routine tests for the highest possible baud rate.
; ---------------------------------------------------------------------
ZCSPEED     PROC    NEAR
            PUSH    AX                      ; save register
ZCSPEED05:  CMP     BAUD_CNTR, 6            ; Q. comm attempts done?
            JB      ZCSPEED10               ; A. no .. try again
            MOV     DX, OFFSET SPDERROR     ; dx -> Comm not possible
            CALL    ZCDIE                   ; die now
ZCSPEED10:  MOV     AL, BAUD_CNTR           ; al = baud rate counter
            CBW                             ; ax = baud rate counter
            CALL    ZCBAUD                  ; .. setup baud rate
            MOV     AX, 2                   ; wait .1 sec
            CALL    ZCWAIT                  ; .. for all to calm down
            MOV     WAIT_COUNT, 0           ; .. and wait counter
            CALL    ZCCLRCOM                ; .. clear out receive buffer
ZCSPEED11:  MOV     AL, STX                 ; al = send stx
            CALL    ZCPUTC                  ; .. send char
            MOV     AX, 1                   ; wait 1 tick
            CALL    ZCWAIT                  ; .. wait
            CALL    ZCGETC                  ; Q. char available?
            JC      ZCSPEED15               ; A. no .. try again
            CMP     AL, STX                 ; Q. stx?
            JE      ZCSPEED17               ; A. yes .. continue
ZCSPEED15:  TEST    FLG1, FLG1B             ; Q. ctl-break?
            JNZ     ZCSPEED16               ; A. yes .. end it now
            TEST    FLG, FLGW               ; Q. wait forever?
            JNZ     ZCSPEED11               ; A. yes .. do so.
            MOV     AX, DSRWAIT             ; ax = current wait count
            CMP     WAIT_COUNT, AX          ; Q. time expire?
            JNA     ZCSPEED11               ; A. no.. try again
            MOV     DX, OFFSET NOTUP        ; dx -> error message
            CALL    ZCDIE                   ; .. die gracefully
ZCSPEED16:  MOV     DX, OFFSET SHUTDOWN_R1  ; dx -> ZCOPY done msg
            CALL    ZCDIE                   ; .. end gracefully
ZCSPEED17:  CALL    ZCCLRCOM                ; clear receive buffer
            CALL    ZCLSRGET                ; assure old lsr killed
            MOV     DSRWAIT, BSC_3          ; reset dsrwait
            TEST    FLG,FLGR                ; Q. are we the receiver?
            JNZ     ZCSPEED50               ; A. yes .. sync as such
; SENDING MODE
            CALL    ZCSPDA                  ; Q. first part ok?
            JC      ZCSPEED80               ; A. no .. try next baud
            CALL    ZCSPDB                  ; Q. second part ok?
            JC      ZCSPEED80               ; A. no .. try next baud
            JMP     SHORT ZCSPEED90         ; else.. exit ok
; RECEIVING MODE
ZCSPEED50:  CALL    ZCSPDB                  ; Q. answer to first part ok?
            JC      ZCSPEED80               ; A. no .. try next baud
            CALL    ZCSPDA                  ; Q. answer to second ok?
```

(ZCOPY.ASM continues)



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```
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```

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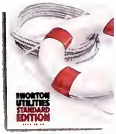

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determine the exact nature of the problem, report it and, in most cases, fix it for you.

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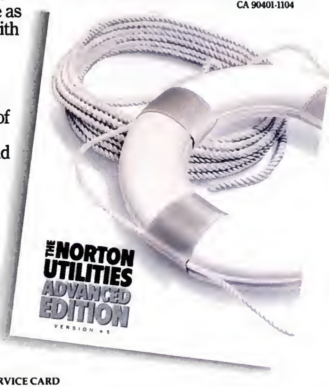

CIRCLE 302 ON READER SERVICE CARD

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CIRCLE 118 ON READER SERVICE CARD

```
            JNC     $CSPEED95              ; A. no .. try next baud
$CSPEED80:  INC     BAUD_CNTR              ; next baud rate
            JMP     $CSPEED05              ; .. try re-sync
$CSPEED50:  CALL    $CCLRCOM               ; assure all bytes cleared
            MOV     DX, OFFSET SPDSET      ; dx -> ok message
            MOV     AH, 9                  ; ah = print to "$"
            INT     21h                    ; display message
            POP     AX                     ; restore caller's regs
            RET                            ; .. and return to caller
$CSPEED     ENDP
; ----------------------------------------------------------------------
; This routine is one side of the set baud rate routine -- sender.
; Exit: Carry set if unsuccessful.
; ----------------------------------------------------------------------
$CSPDA      PROC    NEAR
            MOV     DX, WAIT_COUNT         ; dx = current wait count
            ADD     DX, 8                  ; dx = future wait count
$CSPDA12:   MOV     AL, SYNC_BYTE          ; al = start signature byte
            CALL    $CPUTC                 ; .. put it out
            MOV     AX, 1                  ; ax = wait 1 tick
            CALL    $CWAIT                 ; .. wait 1 tick
            CALL    $CGETC                 ; Q. char available?
            JC      $CSPDA17               ; A. no .. continue
            CMP     AL, STX                ; Q. stx?
            JNE     $CSPDA15               ; A. no .. continue
            CALL    $CPUTC                 ; .. send STX back
            JMP     $CSPDA12               ; .. and do it again
$CSPDA15:   CMP     AL, ACK                ; Q. ack?
            JE      $CSPDA20               ; A. yes .. send sync string
$CSPDA17:   CMP     DX, WAIT_COUNT         ; Q. time up?
            JA      $CSPDA12               ; A. no .. try again
            JMP     SHORT $CSPDA80         ; return unsuccessful
        SYNC BYTE RECEIVED .. SEND STRING
$CSPDA20:   MOV     AL, SYNC_END           ; al = end of sync sequence
            CALL    $CPUTC                 ; .. write it
            MOV     CX, SYNC_LEN           ; Length of sync string
            XOR     AL, AL                 ; al = sync char
$CSPDA25:   CALL    $CPUTC                 ; put out sync string char
            ADD     AL, SYNC_INC           ; .. calc next char
            LOOP    $CSPDA25               ; .. continue until done
            MOV     AX, 9                  ; ax = .5 sec
            CALL    $CWAIT                 ; .. wait .5 secs
            CALL    $CTSTBRK               ; Q. did break occur?
            JNE     $CSPDA50               ; A. yes .. return successful
$CSPDA80:   STC                            ; return unsuccessful
            RET                            ; .. return to caller
$CSPDA50:   CLC                            ; return successful
            RET                            ; .. return to caller
$CSPDA      ENDP
; ----------------------------------------------------------------------
; This routine is one side of the set baud rate routine -- receiver.
; Exit: Carry set if unsuccessful.
; ----------------------------------------------------------------------
$CSPDB      PROC    NEAR
            MOV     WAIT_COUNT, 0          ; set wait counter to 0
$CSPDB10:   CALL    $CGETC                 ; Q. char available?
            JNC     $CSPDB20               ; A. yes .. check it.
            CMP     WAIT_COUNT, 18         ; Q. 1 second?
            JB      $CSPDB10               ; A. no .. keep trying.
            JMP     SHORT $CSPDB80         ; else .. return unsuccessful
$CSPDB20:   CMP     AL, SYNC_BYTE          ; Q. sync byte received?
            JNE     $CSPDB25               ; A. yes .. answer it.
            MOV     AL, ACK                ; al = ack
            CALL    $CPUTC                 ; .. tell 'em we got it.
            JMP     $CSPDB10               ; .. try for sync end
$CSPDB25:   CMP     AL, SYNC_END           ; Q. end of sync bytes?
            JE      $CSPDB30               ; A. yes .. expect sync string.
            CMP     AL, STX                ; Q. still stxing?
            JNE     $CSPDB10               ; A. no .. continue
            CALL    $CPUTC                 ; else .. tell 'em we got it
            JMP     $CSPDB10               ; .. and try again
$CSPDB30:   CALL    $CSPDCHK               ; Q. block receive ok?
            JC      $CSPDB80               ; A. no .. return unsuccessful
            CALL    $CBREAK                ; else .. tell 'em we're talking
            JMP     SHORT $CSPDB95         ; .. and return to caller
$CSPDB80:   MOV     AX, SEC_1              ; wait 1 second ...
            CALL    $CWAIT                 ; .. wait
            STC                            ; return unsuccessful
            RET                            ; .. return to caller
$CSPDB50:   CLC                            ; return successful
            RET                            ; .. return to caller
$CSPDB      ENDP
; ----------------------------------------------------------------------
; This routine calculates a CRC for a block of characters.
; Entry: si -> character block; cx = # characters to include in calc
; Exit: ax = CRC
; ----------------------------------------------------------------------
$CCRC       PROC    NEAR
            PUSH    SI                     ; save caller regs
            PUSH    BX
            PUSH    CX
            XOR     AX, AX                 ; ax = start value (0)
            ADD     CX, 2                  ; do 2 "additional" bytes
$CCRC05:    PUSH    CX                     ; save cx
            MOV     BL, BYTE PTR [SI]      ; bl = next byte
            INC     SI                     ; si -> next character
            CMP     CX, 2                  ; Q. more than 2 chars left?
            JA      $CCRC08                ; A. yes .. continue
            MOV     BL, 0FFH               ; .. set to 0ffh
$CCRC08:    MOV     CX, 8                  ; 8 bits ..
$CCRC10:    XOR     BH, BH                 ; clear bh
            SHL     BX, 1                  ; shift the next char
            SHL     AX, 1                  ; Q. high bit on?
            JNC     $CCRC20                ; A. no .. do not xor CRC value
            OR      AL, BH                 ; .. include the next bit
            XOR     AX, CRC_VAL            ; .. xor the CRC value
            LOOP    $CCRC10                ; loop 'til done
            JMP     SHORT $CCRC30          ; .. continue when done
$CCRC20:    OR      AL, BH                 ; include the next bit
            LOOP    $CCRC10                ; loop 'til done
$CCRC30:    POP     CX                     ; restore char count
            LOOP    $CCRC05                ; .. continue until done
            POP     CX
            POP     BX
            POP     SI
```

```
            RET
$CCRC       ENDP
; ----------------------------------------------------------------------
; This routine builds a block and sends it to the other machine.
; Block Format: STX crc(2) len(2) blk#(2) cmd(1) data(n) ETX
; where: STX=02h, crc=16 bit error check value, len=length of block (i.e.
; data length+3), blk#=number of this block, 0 thru 65535, wrapping
; cmd=command/identifier for this block, data=send characters, ETX=03h
; Entry: al=command; si->chars to send; cx=# chars to include in calc
; Exit: Returns when transmission complete.
; ----------------------------------------------------------------------
$CBLKSND    PROC    NEAR
            PUSH    AX                     ; save caller's regs
            PUSH    BX
            PUSH    DX
            PUSH    SI
            PUSH    DI
            PUSH    CX
            MOV     DI, SBUF               ; di -> send buffer
            TEST    FLG1, FLG1B            ; Q. control-break detected?
            JZ      $CBLKSND05             ; A. no .. continue
            MOV     AL, DIENOW             ; al = die now command
            OR      FLG1, FLG1S            ; .. show shutdown sent
$CBLKSND05: PUSH    AX
            CLD                            ; we want to increment
            MOV     AL, STX                ; al = stx value
            STOSB                          ; .. save in send buffer
            ADD     DI, 2                  ; di -> past CRC bytes
            MOV     AX, CX                 ; ax = characters string len
            ADD     AX, 3                  ; ax = chars + cmd + blk# len
            STOSW                          ; .. save the length
            MOV     AX, SEND_BLKNO         ; ax = next send block number
            STOSW                          ; save send block number
            POP     AX                     ; restore the command
            STOSB                          ; save the command
            JCXZ    $CBLKSND10             ; jump if no bytes to move
      REP   MOVSB                          ; .. move in the chars
$CBLKSND10: MOV     AL, ETX                ; al = etx value
            STOSB                          ; .. save at end of buffer
            MOV     BX, SBUF               ; bx -> buffer
            MOV     CX, [BX+MLEN]          ; cx = blk#+cmd+data len
            LEA     SI, [BX+MBLKNO]        ; si -> blk#/cmd/data area
            CALL    $CCRC                  ; calculate the crc
            MOV     [BX+MCRC], AX          ; .. save in the buffer
            MOV     DL, RETRIES            ; dl = max retries
$CBLKSND20: MOV     SI, BX                 ; si -> buffer
            MOV     CX, [BX+MLEN]          ; cx = blk#/cmd/data length
            ADD     CX, NOHEAD             ; characters to send
$CBLKSND25: LODSB                          ; al = char to send
            CALL    $CPUTC                 ; .. send it
            LOOP    $CBLKSND25             ; .. loop until all sent
            MOV     BX, WAIT_COUNT         ; bx = now
            ADD     AX, SEC_10             ; bx = later, 10 seconds
$CBLKSND35: CALL    $CWAITC                ; .. and wait for a character
            JC      $CBLKSND60             ; .. timeout .. see if any resp
            CMP     AL, ACK                ; Q. send ok?
            JE      $CBLKSND80             ; A. yes .. continue
            CMP     AL, NAK                ; Q. send bad?
            JE      $CBLKSND75             ; A. yes .. restart send
            CMP     AL, RLR                ; Q. request last response
            JE      $CBLKSND55             ; A. yes .. continue
            JMP     SHORT $CBLKSND70       ; .. clear buffer, retry
$CBLKSND55: CALL    $CGETC                 ; kill the rlr
            MOV     AL, LAST_RESP          ; al = last response sent
            CALL    $CPUTC                 ; .. tell the other machine
            MOV     AX, SBUF               ; bx -> buffer
            JMP     $CBLKSND20             ; .. and resend our block
$CBLKSND60: CMP     WAIT_COUNT, AX         ; Q. 10 seconds yet
            JE      $CBLKSND65             ; A. no .. continue
            MOV     DX, OFFSET NOTUP       ; dx -> error message
            CALL    $CDIE                  ; .. and die now
$CBLKSND65: MOV     AL, RLR                ; al = get last response
            CALL    $CPUTC                 ; .. request last response
            INC     ERRORS                 ; .. increment the error count
            JMP     $CBLKSND35             ; .. and ask other machine
$CBLKSND70: CALL    $CGETC                 ; get a char
            CALL    $CWAITC                ; .. wait for another to arrive
            JNC     $CBLKSND70             ; .. if another does, get it
            JMP     $CBLKSND65             ; .. get last response now.
$CBLKSND75: CALL    $CGETC                 ; .. kill the nak
            INC     ERRORS                 ; increment error count
            MOV     AX, SBUF               ; bx -> buffer
            JMP     $CBLKSND20             ; .. retry
$CBLKSND80: CALL    $CGETC                 ; kill the character
            INC     SEND_BLKNO             ; next send block number
            TEST    FLG1, FLG1S            ; Q. shutdown sent?
            JZ      $CBLKSND95             ; A. no .. continue
            MOV     DX, OFFSET SHUTDOWN_R1 ; dx -> shutdown request
            CALL    $CDIE                  ; .. and end it all
$CBLKSND50: POP     CX                     ; restore length
            POP     DI
            POP     SI
            POP     DX
            POP     AX
            POP     BX
            RET
$CBLKSND    ENDP
; ----------------------------------------------------------------------
; This routine waits for a character, .5 secs.
; Exit: carry=TIMEOUT; no carry=char received; al = character
; ----------------------------------------------------------------------
$CWAITC     PROC    NEAR
            PUSH    BX
            MOV     BX, WAIT_COUNT         ; bx = now ..
            ADD     BX, 13                 ; bx = later (.5 secs) ..
$CWAITC10:  CALL    $CCLA                  ; Q. char available?
            JNC     $CWAITC95              ; A. yes .. return
            CMP     WAIT_COUNT, BX         ; Q. .5 secs?
            JE      $CWAITC10              ; A. no .. continue
            STC                            ; show timeout
            JMP     SHORT $CWAITC95        ; .. return to caller
$CWAITC95:  POP     BX                     ; .. return to caller
            RET                            ; .. and return to caller
$CWAITC     ENDP
```

(ZCOPY.ASM continues)

```
; ----------------------------------------------------------------------
; This routine receives a block, checks CRC, ACKs its reception and places
; the data in wbuf.  STX of block should have already been read and discarded
; The block format is documented in ZCBLKSND.
; Exit: Carry - block not available (timeout or bad crc).
; No Carry - block received ok, in wbuf, starting w/CRC; al = command byte
; ----------------------------------------------------------------------
ZCBLKRCV     PROC    NEAR
             PUSH    AX                       ; save regs
             PUSH    CX
             PUSH    DX
             PUSH    DI
             PUSH    SI
             MOV     BX, WAIT_COUNT           ; bx = current timer
             ADD     BX, 5                    ; bx = max time to wait until
             MOV     CX, 0                    ; zero out char counter
             MOV     DI, WBUF                 ; di -> wbuf
             ADD     DI, MCRC                 ; di -> work buffer crc field
             MOV     DX, -1                   ; .. dummy # chars needed
ZCBLKRCV10:  CALL    ZCGETC                   ; Q. char available?
             JC      ZCBLKRCV30               ; A. no .. error
             MOV     BX, WAIT_COUNT           ; bx = current timer
             ADD     BX, 5                    ; .. next time to wait until
             STOSB                            ; put in wbuf
             INC     CX                       ; cx = # chars
             CMP     CX, 4                    ; Q. len in yet?
             JNE     ZCBLKRCV20               ; A. no .. continue
             MOV     DX, [DI-2]               ; dx = message len
             ADD     DX, 5                    ; dx = # character needed
ZCBLKRCV20:  CMP     CX, DX                   ; Q. enough chars received?
             JE      ZCBLKRCV50               ; A. yes .. check 'em out.
             JMP     SHORT ZCBLKRCV10         ; else .. get another
ZCBLKRCV30:  CMP     WAIT_COUNT, BX           ; Q. timeout?
             JA      ZCBLKRCV70               ; A. yes .. NAK
             JMP     SHORT ZCBLKRCV10         ; .. try again
ZCBLKRCV50:  MOV     SI, WBUF                 ; si -> wbuf
             MOV     CX, [SI+MLEN]            ; cx = length
             PUSH    SI                       ; save wbuf pointer
             LEA     SI, [SI+MBLKNO]          ; si -> blk#
             CALL    ZCCRC                    ; .. calc crc
             POP     SI                       ; si -> wbuf
             CMP     AX, [SI+MCRC]            ; Q. crc same?
             JE      ZCBLKRCV55               ; A. yes .. ok
             JMP     SHORT ZCBLKRCV70         ; .. else .. NAK
ZCBLKRCV55:  MOV     AX, RCV_BLKNO            ; ax = expected block
             CMP     AX, [SI+MBLKNO]          ; Q. same block?
             JE      ZCBLKRCV80               ; A. yes .. continue
             CALL    ZCCLRCOM                 ; else .. clear com buffer
             MOV     AL, ACK                  ; al = ack
             MOV     LAST_RESP, AL            ; .. save as last resp
             CALL    ZCPUTC                   ; .. ack last block
             STC                              ; show no receive
             JMP     SHORT ZCBLKRCV90         ; .. return to caller
ZCBLKRCV70:  MOV     AL, NAK                  ; al = NAK
             MOV     LAST_RESP, AL            ; .. save as last resp
             CALL    ZCPUTC                   ; .. tell remote .. no go
             INC     ERRORS                   ; increment error count
             STC                              ; show error condition
             JMP     SHORT ZCBLKRCV90         ; .. and return to caller
ZCBLKRCV80:  MOV     AL, ACK                  ; al = ACK
             MOV     LAST_RESP, AL            ; .. save as last resp
             CALL    ZCPUTC                   ; .. tell remote .. all is go
             INC     RCV_BLKNO                ; next block number
             MOV     AL, [SI+MCMD]            ; al = received command
             CMP     AL, DIENOW               ; Q. die now?
             JNE     ZCBLKRCV85               ; A. no .. continue
             MOV     DX, OFFSET SHUTDOWN_R1   ; dx -> shutdown msg
             CALL    ZCDIE                    ; .. end it all now
ZCBLKRCV85:  CLC                              ; show received ok
ZCBLKRCV90:  POP     SI                       ; restore regs
             POP     DI                       ; Save regs
             POP     DX
             POP     CX
             POP     BX
             RET
ZCBLKRCV     ENDP
; ----------------------------------------------------------------------
; Determine if chars are available.  If so, attempt to receive a block.
; Exit: CY=block not available; NC=block received ok, in wbuf, starting w/CRC.
;       al = command byte
; ----------------------------------------------------------------------
ZCTRYRCV     PROC    NEAR
             CALL    ZCGETC                   ; Q. any chars available?
             JC      ZCTRYRCV90               ; A. no .. exit
             CMP     AL, STX                  ; Q. stx received?
             JNE     ZCTRYRCV60               ; A. no .. exit
             CALL    ZCBLKRCV                 ; receive a block
             JMP     SHORT ZCTRYRCV90         ; tell 'em how it went
ZCTRYRCV60:  CMP     AL, RLR                  ; Q. request of last resp?
             JNE     ZCTRYRCV70               ; A. no .. show no block
             MOV     AL, NAK                  ; al = resend last block
             CALL    ZCPUTC                   ; .. send the response
ZCTRYRCV70:  STC                              ; show no block
ZCTRYRCV90:  RET                              ; .. and exit
ZCTRYRCV     ENDP
; ----------------------------------------------------------------------
; This routine subtracts the IO_LEN from the bytes in the current file, and
; prints the number of blocks left to transfer on each 10h blocks transferred
; ----------------------------------------------------------------------
ZCPRTLFT     PROC    NEAR
             PUSH    AX                           ; save regs
             PUSH    CX
             CMP     WORD PTR BYTESLFT+2, 0       ; Q. < 64k bytes to go?
             JA      ZCPRTLFT10                   ; A. no .. continue
             CMP     WORD PTR BYTESLFT, IO_LEN    ; Q. io_len left?
             JA      ZCPRTLFT10                   ; A. yes .. continue
             MOV     WORD PTR BYTESLFT, 0         ; zero out bytes left
             JMP     SHORT ZCPRTLFT80             ; ... and print!
ZCPRTLFT10:  SUB     WORD PTR BYTESLFT, IO_LEN    ; subtract transferred
             SBB     WORD PTR BYTESLFT+2, 0       ; .. from left to xfer
             MOV     AX, WORD PTR BYTESLFT        ; get # bytes left (lsw)
             AND     AX, 1000H                    ; Q. 16 block boundary?
             JNZ     ZCPRTLFT90                   ; A. no .. skip print
ZCPRTLFT80:  CALL    ZCPRBLKS                     ; .. print # blocks left
ZCPRTLFT90:  POP     CX                           ; restore regs
             POP     AX
             RET                                  ; .. return to caller
ZCPRTLFT     ENDP
; ----------------------------------------------------------------------
; This routine calculates and prints the number of blocks left.
; ----------------------------------------------------------------------
ZCPRBLKS     PROC    NEAR
             PUSH    AX                       ; restore es
             PUSH    BX
             PUSH    CX
             PUSH    DX
             PUSH    DI
             PUSH    ES                       ; save es
             LES     BX, BYTESLFT             ; bx = bytes left
             MOV     DX, ES                   ; dx = high order
             POP     ES                       ; .. restore es
             CLC                              ; clear the carry bit
             RCR     DX, 1                    ; move lsb of dx to cf
             RCR     BX, 1                    ; .. continue in bx
             MOV     BL, BH                   ; bl = low order
             MOV     BH, DL                   ; bh = middle
             MOV     DL, DH                   ; dl = high
             XOR     DH, DH                   ; .. high is zero
             MOV     DI, OFFSET B_LEFT        ; di -> blocks left
             STD                              ; .. and count down
             MOV     CX, 6                    ; .. max bytes to do
ZCPRBLKS20:  PUSH    CX                       ; save counter
             MOV     AL, BL                   ; al = digit
             AND     AL, 0FH                  ; .. upper bits off
             OR      AL, 30H                  ; change to printable
             CMP     AL, '9'                  ; Q. above '9'?
             JNA     ZCPRBLKS25               ; A. no .. continue
             ADD     AL, 7                    ; .. convert to prtable
ZCPRBLKS25:  STOSB                            ; save the char
             MOV     CL, 4                    ; cl = shift value
ZCPRBLKS27:  CLC                              ; clear the carry bit
             RCR     DX, 1                    ; rotate dx:bx ..
             RCR     BX, 1                    ; .. by as many bits as needed
             LOOP    ZCPRBLKS27               ; .. continue
             POP     CX                       ; .. restore count
             OR      BX, BX                   ; Q. all done?
             JNZ     ZCPRBLKS30               ; A. no .. continue
             OR      DX, DX                   ; Q. all done?
             JZ      ZCPRBLKS40               ; A. yes .. print it
ZCPRBLKS30:  LOOP    ZCPRBLKS20               ; .. xlst next char
ZCPRBLKS40:  LEA     DX, [DI+1]               ; dx -> message to print
             MOV     AH, 9                    ; .. ah = print ascii$
             INT     21H                      ; .. ask DOS to do it
             CLD                              ; .. return direction to up
             POP     DI                       ; restore registers
             POP     DX
             POP     CX
             POP     BX
             POP     AX
             RET
ZCPRBLKS     ENDP
; ----------------------------------------------------------------------
; Determine if speed sync string received ok.
; Entry: Receive buffer should have sync string.
; Exit: Carry bit set indicates sync error.
; ----------------------------------------------------------------------
ZCSPDCHK     PROC    NEAR
             CALL    ZCLSRGET                 ; Q. did lsr change?
             JNC     ZCSPDCHK10               ; A. no .. check received string
             AND     AL, LSR_ERR              ; Q. any error?
             JNZ     ZCSPDCHK90               ; A. yes .. return.
ZCSPDCHK10:  MOV     CX, SYNC_LEN             ; len of speed set
             MOV     BL, 0                    ; start of speed string
ZCSPDCHK20:  MOV     AX, WAIT_COUNT           ; ax = wait counter
             ADD     AX, 2                    ; .. wait 2 ticks, max
ZCSPDCHK25:  CALL    ZCGETC                   ; Q. any char?
             JNC     ZCSPDCHK30               ; A. yes ... check it
             CMP     WAIT_COUNT, AX           ; Q. count up?
             JB      ZCSPDCHK25               ; A. no .. check again.
             JMP     SHORT ZCSPDCHK90         ; .. else .. error
ZCSPDCHK30:  CMP     AL, BL                   ; Q. same character?
             JNE     ZCSPDCHK90               ; A. no .. error
             ADD     BL, SYNC_INC             ; bl = next char
             LOOP    ZCSPDCHK20               ; .. check next char
             CLC                              ; show sync ok
             RET                              ; .. return to caller
ZCSPDCHK90:  STC                              ; show no sync
             RET                              ; .. return to caller
ZCSPDCHK     ENDP
; ----------------------------------------------------------------------
; This routine causes a prompt to be placed on both machines.
; The response may be given from either machine.
; Entry: di -> prompt message, ended in $
; Exit: al = response
; ----------------------------------------------------------------------
ZCSPROMPT    PROC    NEAR
             PUSH    BX                       ; save registers
             PUSH    CX
             PUSH    DX
             PUSH    SI
             PUSH    DI
             CLD                              ; clear direction
             PUSH    DI                       ; save initial pointer
             MOV     AL, '$'                  ; Look for $ character
             MOV     CX, 100                  ; .. max 100 chars
     REPNE   SCASB                            ; .. find the value
             MOV     CX, DI                   ; cx -> char after '$'
             POP     SI                       ; si -> start of string
             SUB     CX, SI                   ; cx = length of string
             MOV     AL, OPR_PROMPT           ; al = command (prompt)
             CALL    ZCBLKSND                 ; Q. send ok?
             MOV     DX, SI                   ; dx -> start of string
             CALL    ZCPRESP                  ; prompt & get response
             POP     DI                       ; restore regs
             POP     SI
             POP     DX
             POP     CX
             POP     BX
             RET
ZCSPROMPT    ENDP
```

(ZCOPY.ASM continues)

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```
; -----------------------------------------------------------------------
; This routine displays a prompt and waits for a response.
; The response may be given from either machine.
; Entry: dx -> prompt message, ended in $
; Exit: al = response; Carry=response came from remote machine
;    no carry - response came from local machine
; -----------------------------------------------------------------------
ZCPRESP     PROC    NEAR
            PUSH    SI                          ; save regs
            PUSH    BX
            PUSH    CX
            MOV     AH, 09H                     ; ah = print string
            INT     21H                         ; .. display prompt
            MOV     BX, WBUF                    ; bx -> wbuf
ZCPRESP10:  CALL    ZCTIMUP                     ; update timer
            MOV     AH, 1                       ; ah = query keyboard
            INT     16H                         ; Q. is a key available?
            JZ      ZCPRESP20                   ; A. no .. check for block
            MOV     AH, 0                       ; ah = get key
            INT     16H                         ; al = key typed
            PUSH    AX                          ; save AX
            MOV     [BX], AL                    ; save response in wbuf
            MOV     AL, OPR_REPLY               ; al = command
            MOV     SI, WBUF                    ; si -> wbuf
            MOV     CX, 1                       ; cx = # chars to send
            CALL    ZCBLKSND                    ; send the block
            POP     AX                          ; restore reply
            CLC                                 ; response from local
            JMP     SHORT ZCPRESP90             ; .. return to caller
ZCPRESP20:  CALL    ZCTRYRCV                    ; Q. block available?
            JC      ZCPRESP10                   ; A. no .. try again
            CMP     BYTE PTR [BX+MCMD], OPR_REPLY   ; Q. reply?
            JNE     ZCPRESP10                       ; A. no .. try again
            MOV     AL, BYTE PTR [BX+MDATA] ; al = response
            STC                                 ; response from remote
ZCPRESP90:  POP     CX                          ; restore regs
            POP     AX
            POP     BX
            RET                                 ; return to caller
ZCPRESP     ENDP
; -----------------------------------------------------------------------
; This routine displays the prompt sent from the other machine.
; Entry: wbuf contains received prompt
; -----------------------------------------------------------------------
ZCPPROMPT   PROC    NEAR
            PUSH    AX                          ; save ax
            MOV     DX, WBUF                    ; dx -> received buffer
            ADD     DX, MDATA                   ; dx -> prompt
            CALL    ZCPRESP                     ; get response
            POP     AX                          ; restore ax
            RET                                 ; return to caller
ZCPPROMPT   ENDP
; -----------------------------------------------------------------------
; This routine sends the requested file.
; Entry: handle = currently opened file.
; -----------------------------------------------------------------------
ZCSEND      PROC    NEAR
            PUSH    AX                          ; save regs
            PUSH    BX
            PUSH    CX
            PUSH    DX
            PUSH    SI
            MOV     AL, CRE_FILE                ; al = file header cmd
            MOV     CX, DTA_LEN                 ; cx = find file data
            MOV     SI, DTA                     ; si -> dta
            CALL    ZCBLKSND                    ; send the request
            CALL    ZCRECV                      ; get the response
            CMP     AL, MSG_MAX                 ; Q. create ok?
            JNE     ZCSEND10                    ; A. yes .. continue
            MOV     DX, OFFSET FILENOPEN        ; dx -> error message
            MOV     AH, 9                       ; ah = print ascii$
            INT     21H                         ; .. tell 'em, Jim
            JMP     SHORT ZCSEND90              ; try next file
ZCSEND10:   MOV     CX, XBUF_LTS                ; cx = bytes left to send
            OR      CX, CX                      ; Q. any?
            JNE     ZCSEND20                    ; A. yes .. send them
            MOV     AH, 3FH                     ; ah = read from file
            MOV     BX, HANDLE                  ; .. bx = file handle
            MOV     CX, XBUF_BSL                ; .. cx = # of bytes
            MOV     DX, XBUF                    ; .. dx -> buffer
            MOV     XBUF_PTR, DX                ; .. save in send pointer
            INT     21H                         ; .. read a buffer full
            JC      ZCSEND80                    ; .. process errors
            OR      AX, AX                      ; Q. anything read?
            JZ      ZCSEND70                    ; A. no .. eof
            MOV     CX, AX                      ; cx = number of bytes
            MOV     XBUF_LTS, BX                ; .. left to send
ZCSEND20:   CMP     CX, IO_LEN                  ; Q. more than in io?
            JNA     ZCSEND25                    ; A. no .. send it
            MOV     CX, IO_LEN                  ; cx = bytes to send
ZCSEND25:   SUB     XBUF_LTS, CX                ; adjust pointer
```

(ZCOPY.ASM continues)

```
            MOV     SI, XBUF_PTR               ; .. si -> data
            ADD     XBUF_PTR, CX               ; .. adjust pointer
            MOV     AL, DATA_BLK               ; .. al = data block cmd
            MOV     ERRORS, 0                  ; .. zero out errors
            CALL    ZCBLKSND                   ; .. send a block
            CALL    ZCRECV                     ; wait & execute reply
            CALL    ZCPRTLFT                   ; .. print blocks left
            CMP     ERRORS, MAX_ERRORS         ; Q. too many errors
            JB      ZCSEND10                   ; A. no ..continue
            MOV     AL, RESYNC                 ; al = resync
            MOV     CX, 0                      ; cx = no data to send
            CALL    ZCBLKSND                   ; .. send the block
            CALL    RESYNC_P                   ; resync on too many block erro
            JMP     ZCSEND10                   ; .. and continue
ZCSEND70:   MOV     AL, EOF_MARK               ; al = eof command
            XOR     CX, CX                     ; .. cx = no data
            CALL    ZCBLKSND                   ; .. tell other side
            CALL    ZCRECV                     ; wait for reply
            JMP     SHORT ZCSEND90             ; .. return to caller
ZCSEND80:   MOV     AL, SHUTDOWN               ; al = shutdown command
            XOR     CX, CX                     ; .. cx = no data
            CALL    ZCBLKSND                   ; .. tell other side
ZCSEND90:   POP     SI                         ; restore registers
            POP     DX
            POP     CX
            POP     BX
            POP     AX
            RET
ZCSEND      ENDP
; -----------------------------------------------------------------
; Receive blocks and process them based on request from the other machine.
; -----------------------------------------------------------------
ZCRECV      PROC    NEAR
            MOV     BX, WAIT_COUNT             ; bx = current wait count
            ADD     BX, SEC_10                 ; bx = ten secs from now
ZCRECV00:   CALL    ZCTIMUP                    ; update the timer
            CMP     WAIT_COUNT, BX             ; Q. 10 seconds yet?
            JB      ZCRECV07                   ; A. no .. continue
            MOV     DX, OFFSET NOTUP           ; dx -> error message
            CALL    ZCDIE                      ; .. I'm dead, Jim
ZCRECV07:   CALL    ZCTRYRCV                   ; Q. anything waiting?
            JC      ZCRECV00                   ; A. no.. try again
            CBW                                ; ax = command
            SHL     AL, 1                      ; ax = entry offset
            LEA     BX, MSG_P_TBL-2            ; bx -> message table
            ADD     BX, AX                     ; bx -> run pointer
            CALL    [BX]                       ; .. call requested routine
ZCRECV90:   RET                                ; return to caller
ZCRECV      ENDP
; -------------------------------------
; create the requested file
; -------------------------------------
CRE_FILE_P  PROC    NEAR                       ; create file
            PUSH    AX                         ; save regs
            PUSH    BX
            PUSH    CX
            PUSH    SI
            PUSH    DI
            MOV     WAIT_COUNT, 0              ; clear the wait counter
            MOV     SI, WBUF                   ; si -> received data
            MOV     AX, [SI+MDATA+28]          ; ax =  file size high
            MOV     WORD PTR BYTESLFT+2, AX    ; .. save high value
            MOV     AX, [SI+MDATA+26]          ; ax = file size low
            MOV     WORD PTR BYTESLFT, AX      ; .. save low value
            ADD     SI, MDATA+30               ; si -> file name
            MOV     DI, OFFSET FILENAME        ; di -> file name area
            MOV     CX, 13                     ; .. length to move
        REP MOVSB                              ; move in the file name
            MOV     DX, OFFSET CURDIR          ; dx -> file name to open
            XOR     CX, CX                     ; cx = attributes
            MOV     AH, 3CH                    ; ah = create file
            INT     21H                        ; Q. create ok?
            JC      CRE_FILEP1                 ; A. no .. error
            MOV     HANDLE, AX                 ; save handle
            OR      FLG1, FLG10                ; .. show file is open
            MOV     SI, WBUF                   ; si -> received data
            PUSH    MDATA+22[SI]               ; push file time
            POP     FILETIME                   ; .. pop it
            PUSH    MDATA+24[SI]               ; push file date
            POP     FILEDATE                   ; .. pop it
            MOV     SI, OFFSET FILENAME        ; si -> file created
            CALL    ZCPRTAZ                    ; .. print the name
            MOV     DX, OFFSET BRECVD          ; dx -> being received
            MOV     AH, 09                     ; ah = print ascii$ string
            INT     21H                        ; .. print the string
            CALL    ZCPRBLKS                   ; .. print blocks to send
            MOV     AL, MSG_ACK                ; ack the request
            JMP     SHORT CRE_FILEP2           ; .. continue
CRE_FILEP1: MOV     AH, 9                      ; ah = print ascii$
            MOV     DX, OFFSET FILENOPEN       ; dx -> error message
            INT     21H                        ; .. tell 'em Jim
```

(ZCOPY.ASM continues)

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CIRCLE 382 ON READER SERVICE CARD

```
             MOV      AL, MSG_NAK                ; nak the request
CRE_FILEP2:  MOV      CX, 0                      ; .. no data
             CALL     $CBLKSND                   ; .. reply
             POP      DI                         ; restore regs
             POP      SI
             POP      CX
             POP      BX
             POP      AX
             RET
CRE_FILE_P   ENDP
; ------------------------------------------
; determine if file exists
; ------------------------------------------
QRY_FLE_P    PROC     NEAR                       ; determine if file exists
             PUSH     AX                         ; save caller's regs
             PUSH     CX
             PUSH     DX
             PUSH     SI
             PUSH     DI
             MOV      SI, WBUF                   ; si -> received data
             ADD      SI, MDATA+30               ; si -> file name
             MOV      DI, OFFSET FILENAME        ; di -> file name area
             MOV      CX, 13                     ; .. length to move
        REP  MOVSB                               ; move in the file name
             MOV      DX, OFFSET CURDIR          ; dx -> file name to open
             XOR      CX, CX                     ; cx = attributes
             MOV      AH, 4EH                    ; ah = find first
             INT      21H                        ; Q. file found?
             JC       QRY_FLE_P1                 ; A. no .. error
             MOV      AL, MSG_ACK                ; ack the request
             JMP      SHORT QRY_FLE_P2           ; .. continue
QRY_FLE_P1:  MOV      AL, MSG_NAK                ; nak the request
QRY_FLE_P2:  PUSH     AX                         ; save reply
             MOV      AH, 36H                    ; ah = get free space
             XOR      DL, DL                     ; .. on current drive
             INT      21H                        ; .. via dos
             XOR      DX, DX                     ; dx = 0
             MUL      CX                         ; .. clusters x secs/cluster
             MUL      BX                         ; .. secs x bytes/sector
             MOV      DS:DTA+DTA_LEN, AX         ; save lsw of free
             MOV      DS:DTA+DTA_LEN+2, DX       ; .. and msw
             MOV      CX, DTA_LEN+4              ; cx = find file data len
             MOV      SI, DTA                    ; si -> dta
             POP      AX                         ; .. restore reply
             CALL     $CBLKSND                   ; .. send reply
             POP      DI                         ; restore caller's regs
             POP      SI
             POP      DX
             POP      CX
             POP      AX
             RET
QRY_FLE_P    ENDP
; ------------------------------------------
; process shutdown request
; ------------------------------------------
SHUTDOWN_P   PROC     NEAR                       ; process shutdown request
             MOV      DX, OFFSET SHUTDOWN_B      ; dx -> request
             JMP      $CDIS                      ; .. we'll never return
SHUTDOWN_P   ENDP
; ------------------------------------------
; ack received
; ------------------------------------------
MSG_ACK_P    PROC     NEAR                       ; process ack
             CLC                                 ; show ack received
             RET
MSG_ACK_P    ENDP
; ------------------------------------------
; process nak request
; ------------------------------------------
MSG_NAK_P    PROC     NEAR                       ; process nak
             STC                                 ; show nak received
             RET
MSG_NAK_P    ENDP
; ------------------------------------------
; process data block
; ------------------------------------------
DATA_BLK_P   PROC     NEAR                       ; process data block
             MOV      BX, WBUF                   ; bx -> buffer
             LEA      DX, [BX+MDATA]             ; dx -> data area
             MOV      DI, XBUF_PTR               ; di -> build buffer
             MOV      SI, DX                     ; si -> input data
             MOV      CX, [BX+MLEN]              ; cx = buffer length
             SUB      CX, 3                      ; .. exclude cmd & blkno
             CLD                                 ; .. positive direction
        REP  MOVSB                               ; .. move data to buffer
             MOV      XBUF_PTR, DI               ; save new o/p ptr
             MOV      SI, XBUF                   ; si -> xbuf
             ADD      SI, XBUF_WL                ; si -> write pos
             CMP      DI, SI                     ; Q. write?
             JB       DATA_BLK90                 ; A. no .. continue
             MOV      CX, XBUF_PTR               ; cx -> past data
             MOV      DX, XBUF                   ; dx -> data
             SUB      CX, DX                     ; cx = data length
             MOV      XBUF_PTR, DX               ; .. save put pointer
             MOV      BX, HANDLE                 ; bx - handle
             MOV      AH, 40H                    ; ah = write
             INT      21H                        ; .. write file
DATA_BLK90:  CALL     $CPRTLFT                   ; print $ blocks left
             MOV      AL, MSG_ACK                ; ack the msg
             XOR      CX, CX                     ; .. no data
             CALL     $CBLKSND                   ; .. send it
             RET
DATA_BLK_P   ENDP
; ------------------------------------------
; process eof request
; ------------------------------------------
EOF_MARK_P   PROC     NEAR                       ; process eof
             MOV      CX, XBUF_PTR               ; cx -> past data
             MOV      DX, XBUF                   ; dx -> data
             SUB      CX, DX                     ; Q. any to write?
             JZ       EOF_MARK80                 ; A. no .. close & exit
             MOV      XBUF_PTR, DX               ; .. save put pointer
             MOV      BX, HANDLE                 ; bx - handle
             MOV      AH, 40H                    ; ah = write
             INT      21H                        ; .. write file
EOF_MARK80:  MOV      BX, HANDLE                 ; bx = handle to close
```

```
             TEST     FLG, FLGD                  ; Q. same machine date?
             JNZ      EOF_MARK85                 ; A. yes .. skip sent date.
             MOV      AX, 5701H                  ; ax = set file date
             MOV      CX, FILETIME               ; cx = file time
             MOV      DX, FILEDATE               ; dx = file date
             INT      21H                        ; set file date & time
EOF_MARK85:  MOV      AH, 3EH                    ; ah = close command
             INT      21H                        ; .. close the file
             AND      FLG1, NOT FLG1O            ; .. show file closed
             MOV      AL, MSG_ACK                ; ack the msg
             XOR      CX, CX                     ; .. no data
             CALL     $CBLKSND                   ; .. send it
             MOV      DX, OFFSET CRLF            ; dx -> crlf
             MOV      AH, 9                      ; ah = print ascii$
             INT      21H                        ; .. display it
             RET
EOF_MARK_P   ENDP
; ------------------------------------------
; process set flags request
; ------------------------------------------
SET_FLG_P    PROC     NEAR                       ; process verify ok
             MOV      BX, WBUF                   ; bx -> received packet
             MOV      AL, MDATA[BX]              ; al = flags sent
             AND      AL, FLG_SET                ; assure other flags off
             OR       FLG, AL                    ; .. turn on other flags
             MOV      AL, FLG                    ; al = new flag set
             AND      AL, FLG_SET                ; .. set off others
             XOR      CX, CX                     ; cx = send no data
             CALL     $CBLKSND                   ; .. return flags
             RET
SET_FLG_P    ENDP
; ------------------------------------------
; resync speed
; ------------------------------------------
RESYNC_P     PROC     NEAR                       ; resync speed
             MOV      DX, OFFSET TOOMANY         ; dx -> message
             MOV      AH, 9                      ; ah = print ascii$
             INT      21H                        ; .. display message
             MOV      DSRWAIT, SEC_30            ; .. reset start wait time
             INC      BAUD_CNTR                  ; .. select next baud rate
             CALL     $CSPEED                    ; .. resync
             CALL     $CCLRCOR                   ; .. clear our recv buffer
             RET
RESYNC_P     ENDP
; ---------------------------------------------------------------------
; This routine will send the requested files.
; Exit: Returns to DOS when all files sent.
; ---------------------------------------------------------------------
$CSP         PROC     NEAR
             MOV      AH, FNDOP                  ; ah = find operation to use
             XOR      CX, CX                     ; cx = attribute to find
             MOV      DX, OFFSET CURDIR          ; dx -> path/filename
             INT      21H                        ; Q. any file found?
             JNC      $CSF05                     ; A. yes .. try to send it
             JMP      $CSF90                     ; .. else .. end of job
$CSF05:      MOV      FNDOP, 4FH                 ; set op to find next
             PUSH     ES                         ; save es
             LES      AX, DS:DWORD PTR DTA_LSIZ    ; es:ax = file size
             MOV      WORD PTR BYTESLFT, AX        ; .. save lsw
             MOV      WORD PTR BYTESLFT+2, ES      ; .. and msw
             POP      ES
             MOV      AX, 3D00H                  ; ax = open for read
             MOV      DX, DTA_NAME               ; ds:dx -> filename to open
             INT      21H                        ; Q. open the file ok?
             JC       $CSP                       ; A. no .. try next file
             MOV      HANDLE, AX                 ; save the handle
             MOV      AL, QRY_FLE                ; al = determine existence
             MOV      CX, DTA_LEN                ; cx = find file data
             MOV      SI, DTA                    ; si -> dta
             CALL     $CBLKSND                   ; send the request
             CALL     $CRECV                     ; Q. does file exist?
             MOV      BX, WBUF                   ; bx -> received buffer
             MOV      AX,WORD PTR DTA_LEN[BX+MDATA]   ; ax = lsw of free
             MOV      DX,WORD PTR DTA_LEN[BX+2+MDATA] ; dx = msw of free
             MOV      FILESSL, AX                ; .. save locally
             MOV      FILESSH, DX                ; .. lsw & msw
             JC       $CSF20                     ; A. no .. continue
             ADD      AX, MDATA+28[BX]           ; add in file's len
             ADC      DX, MDATA+28[BX]           ; .. lsw & msw
             MOV      FILESSL, AX                ; .. save locally
             MOV      FILESSH, DX                ; .. lsw & msw
             TEST     FLG, FLGD                  ; Q. overwrite?
             JNZ      $CSF20                     ; A. yes .. make it so
             TEST     FLG, FLGU                  ; Q. update?
             JZ       $CSF10                     ; A. no .. ask operator
             MOV      BX, WBUF                   ; bx -> recv'd message
             MOV      AX, MDATA+24[BX]           ; ax = receiver's file date
             CMP      AX, DS:DTA_DATE            ; Q. is receivers file older?
             JB       $CSF20                     ; A. yes..  send our's
             JA       $CSF80                     ; A. younger .. skip it
             MOV      AX, MDATA+22[BX]           ; ax = receiver's file time
             CMP      AX, DS:DTA_TIME            ; Q. is receivers file older?
             JB       $CSF20                     ; A. yes .. send our's
             JMP      SHORT $CSF80               ; .. else .. skip
$CSF10:      MOV      DX, OFFSET FILEXISTS       ; dx -> message
             CALL     $CPPR                      ; .. issue overwrite prompt
             CMP      AL, 'Y'                    ; Q. overwrite?
             JE       $CSF20                     ; A. yes .. do it
             CMP      AL, 'N'                    ; Q. do not overwrite?
             JE       $CSF80                     ; A. yes ... skip file
             JMP      SHORT $CSF10               ; .. retry prompt
$CSF20:      MOV      AX, DS:DTA_HSIZ            ; ax = hi file size
             CMP      AX, FILESSH                ; Q. is our file smaller?
             JB       $CSF30                     ; A. yes .. start transfer
             JA       $CSF25                     ; A. no .. check for abort
             MOV      AX, DS:DTA_LSIZ            ; .. get low order
             CMP      AX, FILESSL                ; Q. is our file smaller?
             JNA      $CSF30                     ; A. yes .. start transfer
$CSF25:      TEST     FLG, FLGA                  ; Q. abort if too big?
             JNZ      $CSF80                     ; A. no .. next file
             MOV      SI, DTA_NAME               ; si -> file name
             CALL     $CPRTAZ                    ; .. display it
             MOV      DX, OFFSET TOOBIG          ; dx -> too big message
             MOV      AH, 9                      ; ah = print to $
             INT      21H                        ; .. display message
             JMP      SHORT $CSF80               ; .. next file
```

(ZCOPY.ASM continues)

■ UTILITIES

```
ZCSF20:     MOV     DI, OFFSET DISKFULL     ; di -> full prompt
            CALL    ZCBPROMPT               ; .. tell the user
            JMP     SHORT ZCSF90            ; .. shutdown
ZCSF30:     MOV     SI, DTA_NAME            ; si -> filename
            CALL    ZCPRTAS                 ; print the
            MOV     DX, OFFSET BSENT        ; dx -> being sent
            MOV     AH, 09H                 ; ah = display ascii$
            INT     21H                     ; display message
            CALL    ZCPRBLKS                ; print blocks left message
            MOV     WAIT_COUNT, 0           ; .. clear the wait count value
            CALL    ZCSEND                  ; .. and send the file
            MOV     DX, OFFSET CRLF         ; dx -> crlf
            MOV     AH, 9                   ; ah = print ascii$
            INT     21H                     ; .. display it
ZCSF80:     MOV     BX, HANDLE              ; bx = handle of last file
            MOV     AH, 3EH                 ; ah = close file opcode
            INT     21H                     ; .. file closed, captain!
            JMP     ZCSF                    ; .. try next file
ZCSF90:     MOV     AL, SHUTDOWN            ; al = shutdown command
            XOR     CX, CX                  ; .. no data is sent
            CALL    ZCBLKSND                ; send the command
            MOV     DX, OFFSET SHUTDOWN_S   ; dx -> shutdown string
            JMP     ZCDIE                   ; end gracefully
ZCSF        ENDP
; ---------------------------------------------------------------------
; This routine will display the requested string.
; Entry: si -> string to print.
; ---------------------------------------------------------------------
ZCPRTAS     PROC    NEAR
            PUSH    AX                      ; save regs
            PUSH    DX
            PUSH    SI
            MOV     AH, 02H                 ; ah = display character
ZCPRTAS10:  LODSB                           ; al = char to prt
            OR      AL, AL                  ; Q. anything to prt?
            JZ      ZCPRTAS90               ; A. no .. return
            MOV     DL, AL                  ; dl = char to prt
            INT     21H                     ; .. display the char
            JMP     ZCPRTAS10               ; .. next char
ZCPRTAS90:  POP     SI                      ; restore regs
            POP     DX
            POP     AX
            RET                             ; return to caller
ZCPRTAS     ENDP
; ---------------------------------------------------------------------
; This routine will build a prompt for both machines.
; Entry: filename in the DTA contains file name; dx -> prompt string to use
; Exit: Al = reply char, upper case
; ---------------------------------------------------------------------
ZCFPR       PROC    NEAR
            PUSH    SI                      ; save regs
            PUSH    DI
            MOV     DI, XBUF                ; di -> work area
            MOV     SI, DTA_NAME            ; si -> filename
ZCFPR10:    LODSB                           ; al = char from filename
            OR      AL, AL                  ; Q. end of name?
            JZ      ZCFPR20                 ; A. yes .. next field
            STOSB                           ; .. save in xbuf
            JMP     SHORT ZCFPR10           ; process next char
ZCFPR20:    MOV     SI, DX                  ; dx -> prompt
ZCFPR25:    LODSB                           ; al = prompt char
            STOSB                           ; .. save it
            CMP     AL, '$'                 ; Q. end of prompt?
            JNE     ZCFPR25                 ; A. no .. continue
            MOV     DI, XBUF                ; di -> xbuf
            CALL    ZCSPROMPT               ; issue prompt
            AND     AL, NOT 20H             ; response to upper case
            POP     DI                      ; restore regs
            POP     SI
            RET                             ; return to caller
ZCFPR       ENDP
; ---------------------------------------------------------------------
; This routine transfers ZCOPY out the port in AX.
; Entry: dx = port to transfer on; cx = # chars to send
; Exit: stops via int 2 - debug better be there
; ---------------------------------------------------------------------
ZCXFER      PROC    NEAR
            MOV     SI, 0FEH                ; si -> start of area to send
            MOV     WORD PTR [SI], CX       ; set up length of program
            ADD     CX, 2                   ; add in length
ZCXFER10:   ADD     DX, 5                   ; dx -> lsr
            IN      AL, DX                  ; al = lsr
            SUB     DX, 5                   ; dx -> base port
            TEST    AL, LSR_THRE            ; Q. thr empty?
            JZ      ZCXFER10                ; A. no .. wait
            LODSB                           ; al = char to send
            OUT     DX, AL                  ; .. send the char
            LOOP    ZCXFER10                ; .. loop til done
            INT     2                       ; then return to debug
ZCXFER      ENDP
;   Uninitialized data areas
UDATA       EQU     $                       ; start of uninitialized data
IO_BASE     EQU     WORD PTR UDATA          ; base com port address
INT_VECTOR  EQU     BYTE PTR IO_BASE+2      ; interrupt vector to use
OLD_COM     EQU     DWORD PTR INT_VECTOR+1  ; old interrupt for com:
OLD_TIMER   EQU     DWORD PTR OLD_COM+4     ; old interrupt for timer tick
OLD_CTLBRK  EQU     DWORD PTR OLD_TIMER+4   ; old interrupt for control break
OLD_DOSCTLB EQU     DWORD PTR OLD_CTLBRK+4  ; old interrupt for dos ^break
OLD_DOSERR  EQU     DWORD PTR OLD_DOSCTLB+4 ; old interrupt for dos error
HANDLE      EQU     WORD PTR OLD_DOSERR+4   ; open file handle
RBUF_GPTR   EQU     WORD PTR HANDLE+2       ; receive buffer next get address
RBUFL       EQU     11000                   ; length of receive buffer
SBUF        EQU     WORD PTR RBUF_GPTR+2    ; send buffer address
SBUFL       EQU     600H                    ; length of send buffer
WBUF        EQU     WORD PTR SBUF+2         ; work buffer address
WBUFL       EQU     500H                    ; length of work buffer
XBUF        EQU     WORD PTR WBUF+2         ; file build buffer
XBUF_PTR    EQU     WORD PTR XBUF+2         ; i/o pointer
EDRV        EQU     BYTE PTR XBUF_PTR+2     ; entry time logged drive
EDIR        EQU     WORD PTR EDRV+1         ; pointer to entry time directory
EDIRL       EQU     65                      ; length of area
FILESZL     EQU     WORD PTR EDIR+2         ; file size low
FILESZH     EQU     WORD PTR FILESZL+2      ; .. and high
FILEDATE    EQU     WORD PTR FILESZH+2      ; file date
FILETIME    EQU     WORD PTR FILEDATE+2     ; file time
BYTESLFT    EQU     DWORD PTR FILETIME+2    ; bytes left to transfer
BUF_START   EQU     BYTESLFT+4              ; start of buffer space

CSEG        ENDS
            END     START
```

(ZCOPY.ASM ends)

```
100 REM - BASIC PROGRAM TO CREATE ZCOPY.COM
110 CLS:PRINT "Creating ZCOPY.COM   ": OPEN "ZCOPY.COM   " AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 1 TO   250
140  LINESUM#=0: LOCATE 2,3: PRINT "Countdown: "   250 - I ;
150  FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160   CHECKSUM# = CHECKSUM# + BYTE: LINESUM# = LINESUM# + BYTE
170   IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180  NEXT J
190  READ LINETOT$: LINECHECK# = VAL("&H"+LINETOT$)
200  IF LINECHECK# = LINESUM# THEN GOTO 220
210  LOCATE 4,2: PRINT "Error in line "  ;  260 +  10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
240 IF CHECKSUM# <> FILECHECK# THEN GOTO 260
250 PRINT: PRINT "ZCOPY.COM    created successfully": SYSTEM
260 PRINT: PRINT "ZCOPY.COM    is not valid!": END
270 DATA E9, F0,  2, E9, 01,  F, 5A, 43, 4F, 50, 59, 20, 31, 2E, 30, 20,   538
280 DATA 28, 63, 29, 20, 43, 6F, 70, 79, 72, 69, 67, 68, 74, 20, 31, 39,   517
290 DATA 38, 39, 20, 5A, 69, 66, 66, 20, 43, 6F, 6D, 6D, 75, 6E, 69, 63,   57B
300 DATA 61, 74, 69, 6F, 6E, 73, 20, 43, 6F, 2E,  D,  A, 50, 43, 20, 4D,   4A5
310 DATA 61, 67, 61, 7A, 69, 6E, 65, 20, FE, 20, 42, 6F, 62, 20, 46, 6C,   602
320 DATA 61, 6E, 64, 65, 72, 73,  D,  A, 24, 1A,  0,  0,  0,  0,  0,  0,   2DA
330 DATA 4D, 4F, 55, 44, 41, 50, 57,  0,  0,  0,  0,  0,  0,  0,  0, 43,   261
340 DATA 4F, 4D,  0,  1, 31, 31, 35, 6B, 20, 24,  2, 35, 37, 2E, 36, 6B,   320
350 DATA 24,  3, 33, 38, 2E, 34, 6B, 24,  6, 31, 39, 2E, 32, 6B, 24,  C,   2EE
360 DATA 39, 36, 30, 30, 20, 24, 18, 34, 38, 30, 30, 20, 24,  0,  0,  0,   23B
370 DATA  B,  0,  0, 2E,  0, 2E, 5C,  0,  0,  0,  0,  0,  0,  0,  0,  0,    B8
380 DATA  0,  0,  0,  0, C9,  D, F8,  C, 06,  D, 0C,  B, 90,  B, D7,  E,   40B
390 DATA 0E,  B, 3D,  B, 1F,  F, 37,  F, 15, 22,  2, 55, 72, 61, 67, 65,   309
400 DATA 3A, 20, 5A, 43, 4F, 50, 59, 20, 73, 6F, 75, 72, 63, 65, 20, 5B,   51B
410 DATA 74, 61, 72, 67, 65, 74, 5D, 20, 5B, 2F, 77, 5D, 5B, 2F, 75, 5D,   5BE
420 DATA 5B, 2F, 6F, 5D, 5B, 2F, 61, 5D, 5B, 2F, 70, 5D, 5B, 2F, 64, 5D,   540
430 DATA  D,  A, 2F, 77, 2D, 77, 61, 69, 74,  D,  A, 2F, 75, 2D, 6E, 65,   45A
440 DATA 77, 65, 72, 20, 66, 69, 6C, 65, 73, 20, 6F, 6E, 6C, 79,  D,  A,   57A
450 DATA 2F, 6F, 2D, 6F, 76, 65, 72, 77, 72, 69, 74, 65,  D,  A, 2F, 61,   559
460 DATA 2D, 61, 62, 6F, 72, 74, 20, 69, 66, 20, 74, 61, 72, 67, 65, 74,   5DB
470 DATA 20, 66, 75, 6C, 6C,  D,  A, 2F, 70, 2D, 70, 61, 75, 73, 65, 20,   4F4
480 DATA 62, 65, 66, 6F, 72, 65, 20, 63, 6F, 70, 79,  D,  A, 2F, 64, 2D,   525
490 DATA 75, 73, 65, 20, 63, 75, 72, 72, 65, 6E, 74, 20, 64, 61, 74, 65,   62E
500 DATA  D,  A, 24, 49, 6E, 76, 61, 6C, 69, 64, 20, 64, 69, 72, 65, 63,   529
510 DATA 74, 6F, 72, 79, 2E,  D,  A, 24, 4E, 6F, 20, 66, 69, 6C, 65, 73,   527
520 DATA 20, 73, 70, 65, 63, 69, 66, 69, 65, 64, 2E,  D,  A, 24, 55, 6E,   4F8
530 DATA 61, 62, 6C, 65, 20, 74, 6F, 20, 63, 72, 65, 61, 74, 65, 2C, 20,   577
540 DATA 73, 6B, 69, 70, 70, 69, 6E, 67, 2E,  D,  A, 24, 49, 6E, 76, 61,   55C
550 DATA 6C, 69, 64, 20, 66, 69, 6C, 65, 6E, 61, 6D, 65, 2E,  D,  A, 24,   503
560 DATA 44, 69, 73, 6B, 20, 66, 75, 6C, 6C, 20, 2E, 2E, 20, 70, 72, 65,   541
570 DATA 73, 73, 20, 61, 20, 6B, 65, 79, 20, 2E, 2E,  D,  A, 24, 20, 62,   409
580 DATA 65, 69, 6E, 67, 20, 73, 65, 6E, 74, 2E,  D,  A, 24, 20, 62, 65,   4CD
590 DATA 69, 6E, 67, 20, 72, 65, 63, 65, 69, 76, 65, 64, 2E,  D,  A, 24,   50E
600 DATA 52, 65, 73, 79, 6E, 63, 69, 6E, 67, 20, 2E, 2E, 2E,  D,  A, 24,   497
610 DATA 3A, 20, 65, 78, 69, 73, 74, 73, 2E, 20, 4F, 76, 65, 72, 77, 72,   5CD
620 DATA 69, 74, 65, 3F,  D,  A, 24, 3A, 20, 77, 6F, 6E, 27, 74, 20, 66,   48B
630 DATA 69, 74, 2C, 20, 73, 6B, 69, 70, 70, 65, 64, 2E,  D,  A, 24, 50,   4D2
640 DATA 72, 65, 73, 73, 20, 61, 20, 6B, 65, 79, 20, 74, 6F, 20, 63, 6F,   59C
650 DATA 6E, 74, 69, 6E, 75, 65, 20, 2E, 2E,  D,  A, 24,  D,  A, 5A, 43,   3FE
660 DATA 4F, 50, 59, 20, 69, 73, 20, 64, 6F, 6E, 65, 2E,  D,  A, 24,  D,   430
670 DATA 42, 61, 75, 64, 20, 72, 61, 74, 65, 20, 24,  D,  A, 4C, 69, 6E,   4C6
680 DATA 6B, 20, 6E, 6F, 74, 20, 65, 73, 74, 61, 62, 6C, 69, 73, 68, 65,   620
690 DATA 64, 2E,  D,  A, 24,  D,  A, 4C, 69, 6E, 6B, 20, 65, 73, 74, 61,   43F
700 DATA 62, 6C, 69, 73, 68, 65, 64, 20,  D,  A, 24,  D,  A, 4F, 74, 68,   486
710 DATA 65, 72, 20, 6E, 6F, 64, 65, 20, 6E, 6F, 74, 20, 64, 65, 74, 65,   5D0
720 DATA 63, 74, 65, 64, 2E,  D,  A, 24, 2E, 2B, 2E, 2E, 2E, 2E, 6B, 20,   3A5
730 DATA 62, 6C, 6F, 63, 6B, 73, 20, 6C, 65, 66, 74, 2E, 20, 20, 20, 20,   4F7
740 DATA 20,  D, 24, BA,  6,  1, B4,  9, CD, 21, AE, D1, 10, 09, 1E, 13,   513
750 DATA  6, 09, 1D, FF,  5, 00, 1D, B0, 10, 01, C3,  0, 11, 09, 1D,  7,   523
760 DATA  6, 09, 1D, BA, 10, 01, C3,  0,  6, 09, 1D, BC, 10, 01, C3,  0,   570
770 DATA  5, 09, 1E, BE, 10, 09, 1D, C0, 10, 01, C3,  0, 40, 09, 1D, C3,   5DF
780 DATA 10, B4, 19, CD, 21, A2, C2, 10, 0B, 36, C2, 10, C6,  4, 5C, 46,   63F
790 DATA 32, D2, B4, 47, CD, 21, E0, 34,  2, E0, 47,  0, E0, B2,  4, F6,   7CF
800 DATA  6, 5A,  1, 00, 75, 30, B0,  9, AE, 5A,  1, B9,  1,  0, E0, F6,   5F0
810 DATA  5, 0B, 1D, 6B,  1, 01, C3, B6,  0, 00, 64,  7, 73,  C, 39, 1E,   53D
820 DATA 6B,  1, 72, F5, BA, BB,  3, 00, 29,  3,  0,  6, 5A,  1, F6,  6,   5C4
830 DATA 5A,  1,  4, 74,  6, 0F, 4F,  3, 00,  F,  0, E9, C1,  A, 00, 10,   595
840 DATA  9, EB, F8, 0D, 16, 9F, 10, EC, 42, 32, C0, EE, 03, C2,  3, EE,   803
850 DATA 03, C2,  2, EC, AE, A1, 10,  4,  0, AE, A2, 10, BA, 01,  5, E0,   700
860 DATA C4,  0, B0,  0, BE, A6, 10, BA, 9A,  5, E0, B9,  0, 00, 1D, BE,   773
870 DATA AA, 10, BA, 93,  5, E0, AE,  0, B0, 23, AE, AE, 10, BA, 93,  5,   742
880 DATA E0, A3,  0, B0, 24, BE, 02, 10, BA, CD,  5, B0, 90,  0, 00, 16,   70A
890 DATA 9F, 10, 03, C2,  2, 09, 16, E9,  5, 09, 16, EF,  5, 42, B0,  7,   60F
900 DATA AE, 42, B0,  0, XB, 03, BA,  3, B0,  5, EE, E4, 21, 0A,  B, A1,   027
910 DATA 10, B4,  1, D2, E4, F6, D4, 22, C4, E6, 21, 00,  B, 50,  1, 00,   79C
920 DATA AE, A1, 10, FE, C0,  C, C8, E6, 20, C3, B0, C7, B6, 20, F8,  6,   925
930 DATA 5B,  1, 40, 74,  0, 0B, 1D, B6, 10, B4, 3E, CD, 21, 0A,  B, A1,   5A0
940 DATA 10, E4, 21, B4,  1, D2, B4,  A, C4, E4, 21, 0B, 16, 9F, 10, 42,   6E7
950 DATA 32, C0, EE, 03, C2,  3, EE, A2, A1, 10,  4,  0, A2, 10, E0,       7C0
960 DATA 36,  0, B0, 1B,  0, A6, 10, 00, 2B,  0, B0, 23, BE, AB, 10, 00,   6C6
970 DATA 26,  0, 1B,  0, A5, A6, 10, 0E, 1B,  0, 00,  0, B0, 24, BE,       611
980 DATA B2, 10, E0, 13,  0, C3, 53,  6, B4, 35, CD, 21, 09, 1C, BC, 44,   625
990 DATA  2, B4, 25, CD, 21,  7, 5E, C3, 16, 52, C5, 14, E4, 25, CD, 21,   5FE
1000 DATA 5A, 1F, C3, 20, 00,  E, 5E,  1, 20, CF, FB, 5B, 80, 20, E6, 20,  664
1010 DATA 54, 2E, FF,  6, 60, A1, 10, FF,  6, 6D,  1, CF, 03,  E, 6D,  1,  556
1020 DATA  0, 74, 17, 1E, B6, 40,  0, BE, D0, 33, C0, 2E, 07,  4, 6D,  1,  523
1030 DATA  1,  6, 6C,  0, 03, 16, 6E,  0, 1F, C3, 9C, 00, E4, D7, 2E,      561
1040 DATA FF, 10, 82, 10, 3C,  1, 74,  0, 2E, 00,  E, 5E,  1, 20, B0,  0,  440
1050 DATA CF, 5E, 53, 52, B0, 20, B6, 20, BA, FF, FF, EC, EB,  0, BA, FF,  9BA
1060 DATA FF, EC, A0,  1, 75, 34, 3C,  4, 75, 1D, 03, BA,  2, EC, BB, F2,  917
1070 DATA F1, 2E, 00,  7, 43, 01, FE, F2, F1, 73,  7, 2E, 09, 1E, FF,  5,  7A3
1080 DATA EB, DC, BE, F2, F1, EB, F4, 02, C2,  3, EC, 2E, A2, 9D,  1, 2B,  A14
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(continues)

ZCOPY.BAS: *As an alternative to using source code, ZCOPY.BAS will create the .COM file when you run it once in BASIC.*

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■ UTILITIES

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1090 DATA C6,  6, 6E,  1, FF, 83, EB,  3, EB, C7, FB, 5A, 5E, 50, CF, 53,   8E6
1100 DATA 31, 62, 66, 30, 8E, 16, 6F, 10, 83, C2,  5, EC, 26, 20, 3C, 20,   56F
1110 DATA 75, F6, 60, 8E, 16, 8F, 10, EB, 6E, 5A, 60, 6E, C2, E8, 1A,  0,   735
1120 DATA 73,  1, C3, 53, 8E, 1E, E8, 10, 43, 2E, 1E,  7,  6, 72,  4, 8E,   4A5
1130 DATA 1E, 12,  6, 86, 1E, E8, 10, 6B, F0, C2, 63, 8E, 1E, E8, 10, 3E,   6BB
1140 DATA 1E, FF,  5, 75,  2, F9, EE,  3, 8A,  7, F0, 5B, C2, E8, 30,  1,   749
1150 DATA BE, 81,  0, E8, 77,  0, 3C, 2F, 74, 41, 3C,  D, 74, 1E, 3C, 20,   4F5
1160 DATA 76, F1, E8, 77,  0, 72, 6F, E8, 63,  0, 3C,  D, 74,  E, 3C, 2F,   610
1170 DATA 74, 36, 3C, 20, 77, F1, C6, 44, FF,  0, EE, E7, C6, 44, FF,  0,   835
1180 DATA 83, 3E, 67,  1,  0, 74, 3F, 83, 3E, 66,  1,  0, 75,  6, C7,  6,   44F
1190 DATA 69,  1, A3,  1, E8, 64,  0, E8,  A,  1, C3, C6, 44, FF,  0, E8,   701
1200 DATA 3E,  0, 3C, 31, 72,  E, 2C, 36, 77,  7, 2C, 31, A2, 72,  1, EB,   462
1210 DATA A2, 0D, 3E, 61,  1, E6,  6,  0, F2, BB, 75,  A, BB,  1, E2, E0,   710
1220 DATA  0,  6, BA,  1, EB, 8D, 0D, 16, CB,  1, E8, B6,  0, 80, 3C, 61,   5FB
1230 DATA 72,  0, 80, 3C, 7A, 77,  3, 80, 24, DF, BC, C3, 8D, 5C, FF, 83,   707
1240 DATA 3E, 67,  1,  0, 76,  6, 80, 1E, 67,  1, EB,  E, 83, 3E, 66,  1,   453
1250 DATA  0, 74,  2, F9, C3, 86, 1E, 66,  1, F0, C3, 8B, 36, 67,  1, E8,   70F
1260 DATA 43,  0, 72,  5, 80,  E, 5A,  1, 80, 8A, 1E, BA,  1, 8B, 36, 60,   450
1270 DATA  1, E8, 31,  0, 72,  C, F6, C3, 80, 74,  C, 8D, 16, CB,  1, E8,   6A0
1280 DATA 61,  0, F9, C3, 80, 74, F4, 3C,  1, 75,  D, C7,  6, 6F, 10, F0,   725
1290 DATA  2, C6,  6, A1, 10,  4, 80, C3, C7,  6, 6F, 10, F0,  2, C6,  6,   616
1300 DATA A1, 10,  3, 60, C3, 53, 8E, DE, FC, 8D, 3B, 6F,  1, E6,  3,  0,   6E6
1310 DATA F3, A6, 74,  3, F9, 5E, C3, 80, 7F,  4, 3A, 74,  6, 86, 7F,  4,   601
1320 DATA  0, 75, F1, 8A, 47,  3, 2C, 30, 3C,  1, 72, E8, 3C,  2, 77, E4,   3C6
1330 DATA F0, 5E, C3, F9,  6, 5B,  1, 80, 74,  6, 62, E8, 6C, FD, 5A, B4,   810
1340 DATA  0, CD, 21, E8,  1, 4C, CD, 21, 56, 67, BB, 81,  0, 8E, F9, AC,   70E
1350 DATA 3C,  E, 74,  E, 3C, 61, 72,  6, 3C, 7A, 77,  2, 2C, 20, 8A, EB,   4EF
1360 DATA EE, 6F, 6E, C3, 8E, 3E, 67,  1, F9,  6, 5A,  1, 80, 76,  4, 8E,   676
1370 DATA 3E, 86,  1, 80, 7D,  1, 3A, 73,  C, 8A, 15, 80, BB, 41, B4,  E,   56E
1380 DATA CD, 21, 83, C7,  2, F6,  6, 5A,  1, 80, 75, 41, 57, 8B, DF, 22,   6BB
1390 DATA C8, E6, 80,  0, FC, F2, BB, 8D, 75, FF, E6,  0,  0, 3E, F3, 74,   8F1
1400 DATA 3A, 4E, 80, 3C, 3C, 74,  7, 41, 30, F3, 74,  3, E0, F3, 46,  E,   630
1410 DATA C9, 74, 20, 83, F9,  C, 77, 20, 66, BF, A7,  1, F3, A4, 5E, 6F,   76E
1420 DATA 3E, F3, 74, 23, 43, 3E, F3, 74,  1, 4B, C6,  4,  0, 8B, D7, B4,   6D6
1430 DATA 3E, CD, 21, 72, 12, BA, 73,  2, E8, 50, FF, BB, 80,  2, E8, 52,   76A
1440 DATA FF, BB, BC,  2, E8, 4C, FF, C3,  3,  6, 6E,  1, 39,  6, 6E,  1,   68D
1450 DATA 76, FA, E8, 47, FD, C3, FA, A8, 8D,  1, 80,  E, 8E,  1,  0, C6,   85A
1460 DATA  6, 6E,  1,  0, F9, 75,  2, F0, C3, F9, C3, 50, 53, 62, 8E, 16,   734
1470 DATA 6F, 10, 83, C2,  3, EC, 8A, D0,  C, 40, EB, E8,  4,  0, E8, C7,   7BB
1480 DATA FF, 24, BF, 5A, C3, EB, 0A, 5E, 50, C3, FF, 36, FF,  5, 8F,  6,   8BE
1490 DATA E8, 10, C3, 60, E8, BF, FF, 72,  4, 2A, E4, EB,  2, A8, 10, 50,   802
1500 DATA C3, 50, 53, 52, 50, BA, 7F,  3, E4,  9, CD, 21, 58, 8E, D8, E1,   75E
1510 DATA  2, D3, E3, 2B, D0, 8D, 67, 74,  1, 8A, 6F, 73,  1, 33, FF, E4,   7D7
1520 DATA  6, CD, 31, F6,  6, 5E,  1, 30, 74,  6, BB, 6C,  3, E8, C3, FB,   6EE
1530 DATA 8E, 16, 6F, 10, 83, C3,  3, EC,  C, 80, FA, EB, 83, BB,  3, 8A,   7F2
1540 DATA C3, EB, 42, 8A, C7, EB, 83, C2,  2, EC, 24, 7F, EB, FB, 5A, 5E,   8A6
1550 DATA 50, C3, 50, 80, 3E, 72,  1,  6, 72,  6, BA, 8B,  3, E8, 63, F9,   6DE
1560 DATA A0, 72,  1, 80, E8, 6A, FF, B8,  2,  0, E8, 3E, FF, C7,  6, 6E,   840
1570 DATA  1,  0,  0, E8, 76, FF, B8,  2, E8,  4, FD, B8,  1,  0, E8, 27,   6BF
1580 DATA FF, E8, 16, FD, 72,  6, 3C,  2, 74, 23, F9,  0, 5E,  1, 20, 75,   635
1590 DATA 16, F9,  6, 5A,  1,  2, 76, DE, A1, C9,  1, 26,  6, 6E,  1, 76,   54E
1600 DATA D6, BB, BB,  2, E8, 4C, FB, BB, 6C,  3, E8, 46, FB, E8, 3A, FF,   6F5
1610 DATA E8,  2, FF, C7,  6, C6,  1, 37,  0, F9,  6, BA,  1, 80, 73,  C,   610
1620 DATA E8, 26,  0, 72, 11, E8, 6E,  0, 72,  C, EB, 11, E8, 66,  0, 72,   630
1630 DATA  6, E8, 13,  0, 73,  7, FB,  6, 72,  1, E9, 76, FF, E8,  A, FF,   742
1640 DATA BB, A5,  3, E4,  6, CD, 21, B8, C3, 8E, 16, 6E,  1, 83, C2,  6,   600
1650 DATA E8,  0, E8, BA, FC, E8,  1,  0, E8, AD, F9, B0, 6F, FC, 72,  D,   674
1660 DATA 3C,  2, 73,  5, E8, 70, FC, EB, E7, 3C,  6, 74,  0, 3E, 16, 6E,   660
1670 DATA  1, 77, DD, EB, 1C, B0,  4, B6, 86, FC, E6, 80,  0, 32, C0, E8,   86C
1680 DATA 5D, FC,  4,  E, E2, F9, E8,  6,  0, E8, 7C, F9, E0, C6, FB, 75,   605
1690 DATA  2, F9, C3, F9, C3, C7,  6, 6E,  1,  0,  0, E8, 5F, FC, 72,  0,   771
1700 DATA 83, 3E, 6E,  1, 12, 72, F4, EB, 22, 3C,  0, 76,  7, B6,  0, E9,   811
1710 DATA 2D, FC, B6, E7, 3C,  6, 74,  0, 3C,  2, 75, DF, B6, 20, FC, EB,   836
1720 DATA DA, E8, 50,  2, 72,  E, E0, 82, FB, EB,  0, E8, 13,  0, E8, 37,   7B6
1730 DATA FB, F9, C3, F0, C2, B6, 53, 61, 23, C0, E2, C1,  2, E1, BA, 1C,   86F
1740 DATA 46, 83, F9,  2, 77,  2, E3, FF, B0,  0,  0, 32, FF, E1, E3, D1,   866
1750 DATA E0, 73,  0,  A, C7, 25, 21, 10, E2, F1, EB,  4,  A, C7, E2, EE,   7F3
1760 DATA 56, E2, DA, 50, 6E, 5E, C3, 50, 53, 52, 56, 57, 51, 8E, 3E, BA,   760
1770 DATA 10, F9,  6, 5E,  1, 20, 74,  7, E8, FF, 80,  E, 6E,  1, 10, 50,   4FC
1780 DATA FC, B6,  2, AA, 83, C7,  2, 8E, C1,  6,  3,  0, AB, A1, 8F,  1,   6E4
1790 DATA BB, 50, BB, E3,  2, F3, A4, B6,  3, BA, 8B, 1E, BB, 10, 8E, 4F,   7D3
1800 DATA  3, 8D, 77,  6, E8, 8E, FF, 86, 67,  1, E2,  3, 8E, F3, 8E, 4F,   76F
1810 DATA  3, 83, C1,  6, BC, E0, 87, FB, E2, FE, 8D, 1E, 6E,  1, 81, C3,   860
1820 DATA B6,  0, E8, 60,  0, 72, 1E, 3C,  6, 74, 67, 3C, 15, 76, 36, 3C,   4C9
1830 DATA 1D, 74,  2, EB, 26, E8, 86, FB, A0, C0,  1, E0, 81, F9, 8B, 1E,   862
1840 DATA BB, 10, EB, C0, 36, 1E, 6E,  1, 72,  6, BB, BB,  2, E8, C3, FC,   7D7
1850 DATA E0, 1E, E0, 4A, F9, FF,  6, 5E,  1, EB, C7, E8, 5F, FB, E8, 2C,   666
1860 DATA  0, 73, F8, EB, EB, E8, 66, FB, FF,  6, 6E,  1, 8E, 1E, BB, 10,   850
1870 DATA EB, 6A, E8, 40, F9, FF,  6, 8F,  1, F9,  6, 5E,  1, 10, 76,  6,   737
1880 DATA BA, 6C,  3, E8, 8D, FC, 60, 6F, 5E, 5A, 6E, 50, C3, 63, 8B, 1E,   77C
1890 DATA 6E,  1, 83, C3,  D, E8, 42, FB, 73,  6, 36, 1E, 6E,  1, 72, F5,   68A
1900 DATA F9, EB,  0, 5E, C3, 52, 61, 62, 67, 66, 8E, 1E, 6E,  1, 83, C3,   700
1910 DATA  5, E6,  0,  0, 8E, 3E, BC, 10, 83, C7,  1, BA, FF, FF, E8, FC,   83A
1920 DATA FA, 72, 1A, 8B, 1E, 6E,  1, 83, C3,  0, BA, 41, 83, F9,  6, 76,   3C6
1930 DATA  6, 8D, 65, FB, 83, C2,  6, 3E, CA, 74,  A, B6, E1, 30, 1E, 6E,   73F
1940 DATA  1, 77, 2E, EB, D9, 8E, 30, BC, 10, 5E, 4C,  3, 56, 8D, 76,  5,   62D
1950 DATA E0, A2, F9, 6E, 3E, 64,  1, 76,  2, EB, 10, E1, A1,  1, 2E, 66,   66F
1960 DATA  5, 74, 1E, E8,  6, FD, B6,  6, A2, C0,  1, E0, 81, FA, F9, EB,   8F7
1970 DATA 26, B6, 15, A2, C0,  1, E8, 86, FA, FF,  6, 5E,  1, F9, EB, 1A,   823
1980 DATA E0,  6, A2, C0,  1, E0, 77, FB, FF,  6, A1,  1, 5A, 44,  7, 3C,   732
1990 DATA FF, 75,  6, BB, 3C,  3, E8, DA, FB, F0, 5E, 6F, 5A, 30, 5E, C2,   8E6
2000 DATA E8, 7A, FA, 72, 13, 3C,  2, 75,  5, B0, 66, FF, EB,  A, 3C, 1E,   737
2010 DATA 76,  5, E0, 13, E8, 40, FA, F9, C2, 50, 61, 83, 3E, CF, 10,  0,   766
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(ZCOPY.BAS continues)

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2020 DATA 77, 20, 01, 3E, CD, 10,  B,  2, 77,  0, C7,  4, CD, 10,  0,  0,   44D
2030 DATA ED, 13, 01, 2B, CD, 10,  0,  3, 03, 1B, CF, 10,  0, A1, CD, 10,   50A
2040 DATA 25,  B, 1E, 75,  3, B0,  3,  0, 50, 50, C3, 50, 53, 51, 52, 07,   4B7
2050 DATA  0, C4, 1B, CD, 10, 5C, C2,  7, F9, D1, DA, D1, DB, 0A, DF, 0A,   55C
2060 DATA F9, 0A, D6, 22, F5, BF, DD,  3, FD, B5,  5,  0, 51, 0A, C3, 24,   05F
2070 DATA  F,  C, 30, 3C, 35, 75,  2,  6,  7, BA, B1,  4, F0, D1, DA, D1,   515
2080 DATA DB, B2, F5, 05,  B, DB, 70,  4,  B, D2, 74,  2, B2, DE, 0D, 55,   053
2090 DATA  1, B4,  0, CD, 21, FC, 5F, 0A, 55, 5B, 50, C3, B0, F7, FB, 73,   07D
2100 DATA  6, 24,  B, 75, 23, B5, 00,  0, B3,  0, A1, 5B,  1,  5,  2,  0,   3CE
2110 DATA B0, CA, F9, 73,  0, 30,  0, 4B,  1, 72, F5, EB,  B, 3A, C3, 75,   7A0
2120 DATA  7, 00, C3,  B, E2, B4, F9, C3, F9, C2, 53, 51, 52, 56, 57, FC,   531
2130 DATA 07, B0, 24, B0, 44,  0, F3, AE, 0B, CF, 5E, 2B, CD, B4,  3, B0,   033
2140 DATA A0, F9, 0B, D4, B0,  0,  0, 5F, 5B, 5A, 55, 5B, C3, 56, 53, 51,   775
2150 DATA B6,  0, CD, 21, 0B, 1B, 5C, 20, E0, E1, F9, B4,  1, CD, 10, 74,   7ED
2160 DATA 17, B4,  0, CD, 14, 00, 00,  7, B0,  B, 0B, 35, BC, 10, B5,  1,   50F
2170 DATA  0, B0, 72, FD, 50, F9, EB,  F, BB, E5, F9, 72, DA, 00, 7F,  7,   0C0
2180 DATA  B, 75, D5, 0A, 47,  0, F9, 55, 5B, 5B, C3, 50, 0B, 15, BC, 10,   5B9
2190 DATA 02, C2,  0, B0, B7, FF, 50, C3, 5B, 53, 51, 52, 56, B4,  1, B0,   00C
2200 DATA 2D,  0, BA, 00,  B, B0, 3F, F9, B0, 06,  0, 3C,  7, 75,  0, BA,   470
2210 DATA 5B,  2, B6,  0, CD, 21, EB, 73, 0B,  B, 5C,  1,  B, C9, 75, 1B,   505
2220 DATA B6, 3F, 0B, 1E, B6, 10, B5,  0, 60, 0B, 16, BE, 10, 05, 10, CD,   635
2230 DATA 10, CD, 21, 72, 4F,  B, C0, 74, 3F, 0B, C0, A3, 5C,  1, 01, F9,   70A
2240 DATA  0,  2, 75,  2, B5,  0,  3, 20,  B, 5C,  1, 0B, 36, C0, 10,  1,   35C
2250 DATA  B, C0, 10, B0,  5, C7,  6, 5E,  1,  0,  0, B0, E9, FC, E0, 36,   6A4
2260 DATA  0, B0, 75, FB, 03, 3E, 5E,  1,  2, 72, AD, B0,  A, B0,  0,  B,   410
2270 DATA B0, D4, FC, B0, D1,  2, EB, A0, D0,  0, 33, C9, B0, C9, FC, E0,   B33
2280 DATA  F,  0, E0,  7, D0,  2, 33, C9, E0, 5C, FC, 5E, 5A, 50, 5B, 50,   716
2290 DATA C3, 0B, 1B, 0B,  1, 01, C3, B0,  0, B0,  0, F0, 29, 1B, 0B,  1,   675
2300 DATA 72,  4, BA, BB,  3, B0, EB, F9, B0, 15, FB, 72, 5C, 00, D0, E0,   A5D
2310 DATA 0D, 1B, B2,  1,  3, D0, FF, 17, C3, 50, 53, 51, 56, 57, C7,  4,   400
2320 DATA 5B,  1,  0,  0, 0B, 34, 5C, 10, 0B, 66, 24, A3, CF, 10, 0D, 64,   53D
2330 DATA 22, A3, CD, 10, 03, C4, 20, BF, A7,  1, B5,  D,  0, F3, A4, BA,   70F
2340 DATA A0,  1, 33, C0, D4, 3C, CD, 31, 72, 2E, A3, B5, 10, 00,  B, 50,   472
2350 DATA  1, 40, 0B, 35, BC, 10, FF, 74, 1B, 0F,  5, CB, 10, FF, 74, 20,   452
2360 DATA 0F,  5, C5, 10, BA, A7,  1, ED, 36,  2, BA, FD,  2, B4,  5, CD,   735
2370 DATA 21, B0, F7, F9, B0,  6, EB,  5, B4,  0, BA, 5B,  2, CD, 21, BB,   05A
2380 DATA  7, B5,  0,  0, B0, 20, FC, 5F, 5E, 55, 5B, 50, C3, 50, 51, 52,   443
2390 DATA 50, 57, 0B, 35, 5C, 10, 02, C6, 20, BF, A7,  1, B0,  D,  0, F3,   5C5
2400 DATA A4, 0A, A5,  1, 33, C9, B6, 4E, CD, 21, 72,  6, B0,  4, EB,  2,   707
2410 DATA B0,  7, 50, B4, 35, 32, D3, CD, 21, 33, D2, F7, B1, F7, B3, A3,   53D
2420 DATA AD,  0, 05, 15, AF,  0, B5, 31,  0, BE, 00,  0, 50, B0, D7, FB,   735
2430 DATA 5F, 5E, 5A, 55, 50, C3, BA, 5B,  3, B5, 17, F9, F9, C3, F9, C3,   524
2440 DATA 0B, 1B, BC, 10, 0D, 57,  0, 0B, 3E, C0, 10, 5B, F2, 0B, 4F,  3,   654
2450 DATA 03, B5,  3, FC, F3, A4, 05, 3B, C0, 10, 0B, 36, BA, 10, 01, C0,   05F
2460 DATA FF, 3A, 3B, FB, 73, 15, 0B,  B, C0, 10, 0B, 15, BA, 10, 2B, CA,   5C7
2470 DATA 05, 15, C0, 10, 0B, 1B, B4, 10, B4, 40, CD, 21, B0, 1A, FD, B0,   76F
2480 DATA  4, 33, C9, B0, 01, FB, C3, 0B,  E, C0, 10, 0B, 15, DA, 10, 2B,   73A
2490 DATA CA, 74,  C, 05, 15, C0, 1B, 0B, 1B, B4, 10, B4, 40, CD, 21, 0B,   655
2500 DATA 1B, D0, 10, F6,  4, BA,  1, 10, 75,  D, B0,  1, 57, 0B,  B, CD,   541
2510 DATA 10, 0B, 10, C9, 10, CD, 21, B4, 3E, CD, 21, 00, 26, 5B,  1, BF,   515
2520 DATA B0,  4, 33, C0, BB, 4B, FB, 0A, 7C,  3, B4,  5, CD, 21, C3, 0B,   005
2530 DATA 1B, 5C, 10, 0A, 67,  0, 26, 7B,  0,  0, 5A,  1, A0, 5A,  1, 24,   3ED
2540 DATA 7B, 33, C9, E0, 21, F9, C3, 0A, 10,  3, B4,  5, CD, 21, C7,  5,   705
2550 DATA C0,  1, 22,  2, F9,  0, 72,  1, B0, B7, F9, B0, 6C, F9, C3, 0A,   077
2560 DATA 25, 50,  1, 33, C0, BA, A5,  1, CD, 21, 73,  3, E5, B3,  0, C6,   6D0
2570 DATA  5, 50,  2, 4F,  0, C4,  4, 5A,  0, A3, CD, 10, 5C,  5, CF, 10,   511
2580 DATA  7, B0,  0, 3D, BA, 5B,  0, CD, 21, 72, D4, A3, B0, 10, B0,  0,   6A9
2590 DATA B0, 2D,  0, BE, 00,  0, B0, CB, FA, B0, 15, F9, 0B, 1E, BC, 10,   044
2600 DATA 0B, 67, 25, 0B, 57, 37, A3, C5, 10, 09, 16, C7, 10, 73, 45,  3,   5C0
2610 DATA 47, 22, 13, 57, 26, A3, C5, 10, 09, 16, C7, 10, F5,  5, 5A,  1,   53C
2620 DATA 40, 75, 21, F9,  0, 5A,  1, 20, 74, 1A, 0B, 1B, BC, 10, 0B, 47,   532
2630 DATA 20, 3B,  6, 00,  0, 72, 1D, 77, 0D, 0B, 67, 1B, 3B,  6, 06,  0,   633
2640 DATA 73, 12, EB, 62, 0A, 20,  3, B0, 00,  0, 3C, 55, 74,  4, 3C, 4B,   5B7
2650 DATA 74, 54, EB, F9, A1, 5C,  B, 3B,  5, C7, 10, 72, 29, 77,  5, A1,   4B4
2660 DATA 5A,  0, 3B,  0, C9, 10, 70, 1B, F9,  0, 5A,  1,  0, 75,  F, BA,   4B5
2670 DATA 5B,  0, B0, 65,  0, BA, 37,  3, B4,  5, CD, 21, EB, 20, BF, D0,   710
2680 DATA  2, B0, 05, FC, EB, 2B, BA, 5B,  0, B0, 33,  0, BA, EE,  3, B4,   056
2690 DATA  0, CD, 21, B0, F9, F9, C7,  5, 5B,  1,  0,  0, B0, D9, FC, BA,   57F
2700 DATA 7C,  3, B4,  0, CD, 21, 0B, 1B, B6, 10, B4, 3B, CD, 21, E9,  B,   670
2710 DATA FF, B0,  2, 33, C0, B0,  F, FA, BA, 5B,  3, E9, 55, F7, 50, 52,   0A1
2720 DATA 56, B4,  2, AC,  A, C0, 74,  6, 0A, D0, CD, 21, EB, F5, 5E, 0A,   7DC
2730 DATA 50, C3, 55, 57, 0B, 3B, BA, 10, BB, 5B,  0, AC,  A, C0, 74,  3,   5A0
2740 DATA BA, BB, F0, 0B, F2, AC, BA, 3C, 24, 75, FA, 0B, 3B, BA, 10, B0,   5AE
2750 DATA 10, FC, 24, DF, 5F, 5B, C3, BB, FB,  0, 05,  C, 03, C1,  2, 03,   7B1
2760 DATA C2,  5, 5C, 03, 0A,  5, A0, 20, 74, F9, AC, EB, E2, F1, CC,  0,   00F
2770 DATA 421052
```

(ZCOPY.BAS ends)

FINDING THE SPEED LIMIT In most communications programs, the speed is preset by the operator. Not so in ZCOPY. The first action ZCOPY performs when it comes up is speed seeking (shown in Figure 2A). Speed seeking is comparable to the automatic shutter setting procedure built into many cameras. In this case, speed seeking is used to find a speed that is acceptable to both machines for transferring data reliably. Generally, 115K or 57.6 kbps will be the rate used.

Speed Seeking

Part A Bps Rate Established By Speed Seeking

Sender		Receiver	Description
STX	→ ←	STX	1. Both set speed to test, send STX
Wait STX		Wait STX	Both wait for character
STX		STX	If STX: Sender goto 2, Receiver goto 3
Timeout		Timeout	Timeouts:
30 seconds		30 seconds	30 seconds—Exit to DOS
/w		/w	/w—No 30-second timeout
1/18 second		1/18 second	1/18 second—goto 1
Not STX		Not STX	Any other char, ignore
SYNC	→		2. Sender sends SYNC
		Await SYNC	3. Receiver looks for SYNC
	←	ACK	If SYNC received, send ACK
	←	STX	If STX received, send STX, goto 3
		Timeout (1 second)	If timeout, goto 1
		Not SYNC	If not SYNC, ignore
Wait ACK			Sender waits for reply
Timeout (1/3 second)			If timeout, goto 2
Not ACK			If not ACK, ignore
SYNC END	→		If ACK received, send SYNC END, continue
		Await SYNC END	Receiver waits for SYNC END
			If SYNC END received, goto 4
	←	STX	If STX received, send STX
		Not SYNC END	Any other char, goto 3
SYNC block	→		Sender sends SYNC block
		Await SYNC block	4. Receiver waits for SYNC block
	←	Break	If OK, break sent back
			If not, wait 1 second, goto 1
Await response			Sender waits for response
Break			If BREAK seen, continue
Timeout			If timeout, goto 1
	←	SYNC	5. Receiver sends SYNC
Await SYNC			6. Sender looks for SYNC
ACK	→		If SYNC received, send ACK
Timeout (1 second)			If timeout, goto 1
Not ACK			Any other char, goto 3
		Wait ACK	Receiver waits for ACK
		Timeout (1/3 second)	If timeout, goto 5
	←	SYNC END	If ACK received, send SYNC END, continue
		Not ACK	If not ACK, goto 5
Await SYNC END			Sender waits for SYNC END
STX	→		If STX received, send STX
SYNC END			If SYNC END received, goto 7
Not SYNC END			Any other char, goto 6
	←	SYNC block	Receiver sends SYNC block
Await SYNC block			7. Sender waits for SYNC block
Break	→		If OK, break sent back
			If not, wait 1 second, goto 1
		Await response	Receiver waits for response
		Break	If BREAK seen, continue
		Timeout	If timeout, goto 1
Speed is synchronized			Start data transfer

The algorithm shown here could be considerably simplified if there were more available channels through which to communicate. For instance, instead of using timeouts and breaks to determine if the speed is acceptable, DSR and CD could be used instead. This would require a more complex cable between the machines, however.

The greatest difficulty in implementing the algorithm is that, upon entry, no form of communications—for example, control lines or data transfer capability—has been established between the two machines. Communications must be established with the only point of reference being agreement between the machines on the starting bit-per-second (bps) rate.

Figure 2: *These diagrams, Parts A through D, illustrate the algorithms ZCOPY uses to transmit data between two computers.*

When ZCOPY starts, it sends a message byte out to the other machine. When ZCOPY sees a return message byte, it knows that something else is out there. ZCOPY selects its next action based on whether it is the sender or receiver.

The sender sends a block of synchronization data to the receiver. This data consists of 256 bytes of information, with which an initial attempt is made to determine the quality of the link. During speed seeking, no error, no matter how small, is tolerated. If even one data error is detected, the current baud rate will be skipped and the next lower rate will be selected.

If the data is transferred successfully to the receiver, the machines reverse the process, the receiver sending an identical block of data for verification by the sender. If this works properly, the machines agree that they have found a good starting speed, and data transfer begins at that rate.

After the transfer has started, error retries are counted as each block is sent. If too many retries are attempted on any given block, the master makes a request to invoke speed seeking again to lower the bit-per-second (bps) rate. The transfer picks up where it left off before the resync request was made. It is not uncommon to see the machines initially synchronize to a rate of 115 kbps, and during a subsequent transfer operation, resync to 57.6 kbps.

PROTOCOL CONSIDERATIONS The protocol used in ZCOPY is a fairly straightforward, three-layer protocol (Figure 2B). As with all protocols, the lowest layer is the physical medium responsible for getting the stream of bits from one end to the other end. In this instance, it comprises the 8250 UARTs with their supporting circuitry and an RS-232 cable.

The next layer is responsible for assuring that a block of data is properly transmitted from one machine to the other. This layer is given a block of data bytes, the length of that block, and an associated command byte, as shown in Figure 3, "ZCOPY Data Block Contents." It places control information (two framing characters, an error checking code, and a block number) around that block and then transmits the block to the other machine. After the block is transmitted, the other machine responds with a positive acknowledgment (ACK) or negative acknowledgment (NAK). If the response is a negative, the block is retransmitted until the other machine receives it properly.

Part B ZCOPY Block Layer Protocol

The Sender and Receiver labels deal with the data flow direction without respect to the Master/Slave function.

A normal block transfer is as follows:

Sender		Receiver	Description
(Block #1)	→		Sender transmits block
	←	ACK	Receiver senses no CRC error and no framing error

The receiver checks the block number of each block successfully received to determine whether that block is new or not. If new, the receiver updates its own internal block number to match that of the received block. If the block was previously received, it is discarded and the receiver continues waiting for a new block.

A block with a data error during transfer:

Sender		Receiver	Description
(Block #2)	→		Sender transmits block
	←	NAK	Receiver senses CRC error, sends NAK to sender

Sender		Receiver	Description
(Block #2)	→		Sender retransmits block
	←	ACK	Receiver gets it OK, sends ACK
			Block may now be processed by receiver

A lost ACK will result in this sequence:

Sender		Receiver	Description
(Block #3)	→		Sender transmits block
	←	ACK	Receiver sends ACK, but the ACK is lost. The receiver does not know this.
Timeout (.5 second) or ???,			Sender continues to wait for ACK but times out or gets non-ACK
(Block #3)	→		
	←	ACK	Receiver sends ACK but will discard block because it already knows about it.
(Block #4)	→		Sender sends block #4
	←	ACK	Receiver sends ACK

Part C Intermachine Command Structure

The following illustrates the blocks that are exchanged between the Master and Slave. The notation is command, data.

Master		Slave	Description
Create file, directory entry	→		
	←	OK, no data -or-	
	←	unable to create, no data	
Query file, Master's directory entry	→		
	←	OK, Slave's directory entry, free space available -or-	
	←	unable to find file, free space available	
Shutdown, no data	→	(Slave returns to DOS)	

Master		Slave	Description
Write data block, data from file	→		
	←	OK, no data	No data error should occur here. The system has already determined that the file will fit on the Slave's drive and the file has been created.
End of file, no data	→		
	←	OK, no data	As in write, a close should represent no error.
Set process flags, Master's flags	→		
	←	Slave's flags ORed with Master's, no data	
Resync, no data	→		
		Resync occurs. No reply needed.	
Prompt, prompt string	→	Both wait for key.	
Key hit, key	→	If key pressed on Master	
	←	Key hit, key If key pressed on Slave	

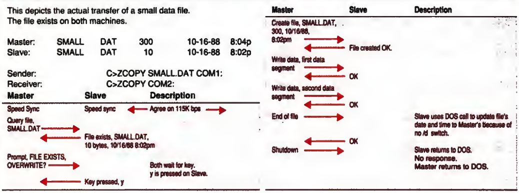
Speed Seeking

Part D Actual Transfer

This depicts the actual transfer of a small data file.
The file exists on both machines.

```
Master:    SMALL   DAT    300        10-16-88   8:04p
Slave:     SMALL   DAT     10        10-16-88   8:02p

Sender:              C>ZCOPY SMALL.DAT COM1:
Receiver:            C>ZCOPY COM2:
```


Master
Slave
Description
Speed Sync
Speed sync
Agree on 115K bps
Query file, SMALL.DAT
File exists, SMALL.DAT, 10 bytes, 10/16/88 8:02pm
Prompt, FILE EXISTS, OVERWRITE?
Both wait for key. y is pressed on Slave.
Key pressed, y
Master
Slave
Description
Create file, SMALL.DAT, 300, 10/16/88, 8:02pm
File created OK.
Write data, first data segment
OK
Write data, second data segment
OK
End of file
Slave uses DOS call to update file's date and time to Master's because of no /d switch.
OK
Shutdown
Slave returns to DOS. No response. Master returns to DOS.

The two framing characters are a low-level check to assure that the block was received intact. By themselves, they represent minimal assurance that the block was transmitted properly, but in context of the overall protocol, they provide one last check of the data block integrity.

The error checking code assures that the data in the block has arrived unchanged. ZCOPY implements something similar to CRC-16 for its error checking. When CRC (Cyclic Redundancy Check) is implemented in circuitry, it is usually implemented as a set of shifts and exclusive ORs of the data as it arrives.

ZCOPY uses a similar algorithm to develop the error check code for the block of data as it receives it. If the check code matches that sent with the block, the data in the block has an extremely high probability of matching what was originally sent.

The block number is incremented sequentially as each block is successfully transferred. This value is used when the acknowledgment from a successful receive is lost. Suppose, for example, that a block is sent and the other machine responds with an ACK, but the ACK itself is lost or garbled. After a timeout, the block will be retransmitted. The block number will not have changed, and the receiver will know this because it maintains the value of the last block it received successfully. When this occurs, the receiver simply ACKs the block again and discards the resent data.

The top layer of the protocol comprises the master and slave functions in the sending and receiving machines, respectively. Figure 2C, "Intermachine Command Structure," shows this aspect of the protocol graphically. The master node sends a request to the slave node and generally then waits for a response from the slave.

For example, suppose the master sends a request asking if the file to be transferred exists (see Figure 2D). The slave will respond with a block indicating the answer. If the file exists, the response block will contain the file's directory information and the master will then use this information in determining its next action.

If the communications went perfectly, the transfer was

```
Master's file status request block sent to slave.
Slave responded with ACK. (block layer)

Slave's file status response sent to master.
Master responds with ACK. (block layer)
```

The most difficult and important aspect of implementing a protocol is timing. All too often, the code that implements a protocol is perfect in terms of performing the actions required but the timing is off.

Timing is generally used to set up windows in which events are supposed to happen. Some of the events affected by timing considerations are:

- How long should we wait for the start of a new block?
- How long should we wait for the next char in a started block?
- How long should we wait for a reply to a sent block?

Based on the complexity of the protocol, the list can become quite long, but poor implementation at any point can greatly impact how well—or, indeed, if—the protocol performs. Suppose, for example, we have assigned a timeout value of 5 seconds as the length of time to wait for the next character in a block. Should a character be lost during the transfer, for whatever reason, we could find ourselves waiting 5 seconds at the end of that block for a byte that will not arrive. On the other hand, suppose we assigned 5 milliseconds to that value instead. It would seem reasonable that once a block has started, the rest should follow immediately. But 5 milliseconds would not be a long enough interval if the transmission speed were below approximately 2,000 bps, because 5 milli-

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ZCOPY.COM Command

Bob Flanders 1989 No. 4 (Utilities)

Purpose: Transfers files at high speed, via a serial link, between machines that do not share a common disk format.

Format:

```
ZCOPY source [target] [/w][/n][/u][/o][/a][/p][/d]
```

Remarks: The two machines must be IBM-compatible and must be connected by a standard "null-modem" cable. ZCOPY is executed, with appropriate parameters, on both machines; a 30-second (default) connect timeout is provided.

On the sending machine both a *source* (filename plus any needed drive and path) and a *target* (COM1 or COM2) must be specified. ZCOPY supports the * and ? DOS filename "wildcards," but it does not permit renaming files during transfer. On the receiving machine the *source* is COM1 or COM2, and the *target*, if specified, must be a directory path. (Any needed subdirectories must be created on the receiving machine before using ZCOPY.)

The optional /w and /*n* switches operate before connection is established, and so are entered on the ZCOPY command line of each machine. The /w parameter prolongs the default connection timeout indefinitely; it can be canceled with Ctrl-Break. The /*n* parameter sets the highest bit-per-second (bps) rate at which ZCOPY will attempt to transfer data. If used, it must be the same on both machines. The default is /1 (115 kilobits per second). Other acceptable values are /2 through /6 (57.6 kbps, 38.4 kbps, 19.2 kbps, 9600 kbps, and 4800 kbps, respectively). If ZCOPY cannot maintain error-free transfer at a given transfer rate, it automatically steps down to the next lower speed.

The other optional parameters may be entered on either machine's ZCOPY command line. The /u (Update) switch permits overwriting same-named files on the receiving machine without operator confirmation if the *source* file is more recent. The /o (Overwrite) switch suppresses the confirmation prompt for all files. By default, when ZCOPY receives a disk-full signal, before aborting it tries to find a smaller selected *source* file that will fit on the receiving disk. The /a (Abort on Full) aborts at the first disk-full indication. The /p (Pause) switch creates a pause before the transfer operation begins after the connection between machines has been made, permitting changing a disk. The /d option changes the date of a received file to that of the receiving machine.

seconds dictates that at least 200 characters per second must arrive to avoid triggering that timeout.

Timing values often interact with one another and must be selected to account for those interactions. Let's return to the example of 5 seconds for the next byte on a started block. Additionally, let's also assign 3 seconds for a reply from a block send.

If a character were lost from a block and the receiver was waiting 5 seconds for the lost character that would never arrive, the sender would time out in 3 seconds and retransmit the block.

It gets worse from here. The receiver hasn't timed out yet, so the beginning of the retransmission is taken as the end of the first block, the one with the missing character. When the receiver believes it has the whole block, the block will presumably fail, either because of the framing characters or by virtue of the CRC value. This would cause the receiver to send a NAK and return to receive mode. Once there, the receiver would start receiving the remainder of the sender's retransmission.

■ Timing values often interact with one another and must be selected to account for those interactions.

Such a round-robin obviously benefits only the common carrier companies. And while this case represents an extreme, it shows how poor planning on the timing issue can radically affect the performance of a protocol.

HANDLING ERRORS By the time the protocol is through with the data block transfer there are no data errors in the current block to be processed, and only the current block has been returned to the actual file transfer routines.

The errors that remain to be handled at this point are the following:

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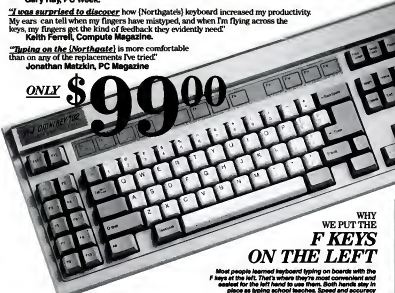
Jonathan Matzkin, PC Magazine



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- Unable to create data file.
- File will not fit on slave's disk.
- Too many transfer errors, resync speed.

To these categories must be added warning conditions:

- File exists, skip or overwrite.
- Update switch, skip or overwrite.

And, finally, there are the good old:

- Abort, Retry, or Ignore
- Ctrl-Break

In the first set, if the master requests that a file be created and the slave is unable to comply, the master tells the operator about it and skips that file. This condition usually occurs if the file is write protected.

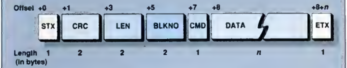
The master detects the second error (file will not fit) when it receives the reply from the file query. The response contains the available space on the slave's target drive. If the amount of space available added to the amount of space to be freed if an existing file is overwritten is less than the size of the file to be sent, the master looks at the /a flag. If this flag is set, the master tells the slave to shut down and then does so itself. If it is not set, the master skips that file.

The third error occurs if too many transfer errors occur during a single block transfer. When the master detects this situation, it issues a resync request to the slave and then begins a resync operation itself. When the resync is completed, the transfer picks up where it left off.

■ When the master queries the slave for the existence of a file and the slave indicates the file exists, the master looks first at the overwrite flag.

The warning conditions are straightforward. When the master queries the slave for the existence of a file and the slave indicates that the file exists, the master looks first at the overwrite (/o) flag. If this is set, it immediately requests that the slave create the file, and it begins the transfer.

ZCOPY Data Block Contents



STX and **ETX** are framing characters. While not a primary error-checking device, together they provide a secondary level of block transfer integrity.

CRC is the error-checking value for the block. This is the major method used to determine block transfer integrity.

LEN is the length of the LEN, BLKNO, CMD, and DATA fields. This is used to tell the application which data is available and in the CRC calculation.

CMD is the command or response value for the block. This field describes the function or response that the block represents.

DATA is the information needed to complete the command. This information varies with the value of the CMD byte and the context in which it is used.

Figure 3: *Each data block that is transferred contains the information above.*

If overwrite was not set, the update (/u) flag is checked. If this flag is set, the master checks its directory entry against the slave's directory entry date and time. If the master's file is newer, it is transferred; otherwise the file is skipped. In the event that neither the /u nor the /o flags were set, ZCOPY asks the operator whether or not to overwrite the file.

The other conditions to be handled are Ctrl-Break and the infamous Abort, Retry, or Ignore. If the program senses that Ctrl-Break has been pressed, it will stop after the current block transfer is complete and request the other machine to return to DOS, after which it does so itself.

When a DOS critical error occurs, the program prompts for an Abort or Retry. If Abort is requested, the program shuts down as quickly as possible. Retry will tell DOS to retry the operation. Ignore and Fail are not supported in ZCOPY.

THE OPERATOR INTERFACE The operator interface follows a fairly simple set of rules. First, the request block always contains a prompt. Second, the response may be exactly one keystroke. Third, only the master can make operator requests.

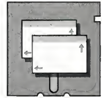
When the master determines that a condition has occurred that requires asking the operator for some information, it builds a prompt, sends it to the slave, displays the prompt on its own screen, and waits for a response either from its own keyboard or from that of the slave. When the master sees the response, it checks the value of the response and, if it is appropriate, it continues processing. If it's not, it retries the operation.

This interface is actually used only in two places in ZCOPY. The first is when /p was supplied on the command line. In this case, ZCOPY sends a prompt and waits until the operator presses any key. The other situation occurs when the operator must be asked whether to overwrite an existing file. Beyond this, the only other operator interface is the DOS command line and the messages with which the program entertains you while it goes about its business.

Bob Flanders is president and senior systems analyst at NCI Systems Inc., in Annandale, Virginia.

■ ENVIRONMENTS ■ CHARLES PETZOLD

SPEAKING THE LANGUAGE OF THE PM API, PART 3



Presentation Manager programs contain a window procedure function that is called from the PM itself. Here's how to understand the strange-looking code that results.

This installment of Environments continues the discussion of the language of the Presentation Manager begun in the two previous issues. At first sight, Presentation Manager programs often have a peculiar look about them. Much of this peculiarity is the result of the programmer's using data types, macros, and identifiers that are defined in the Presentation Manager header files.

What we've considered so far has largely involved the way a program calls Presentation Manager functions. But PM programs have a more intimate link with the operating system than do programs written for conventional environments like DOS or the OS/2 kernel. That's because Presentation Manager programs themselves contain a function that is called from the operating system. (More specifically, it is called from one of the dynamic link libraries that make up the Presentation Manager.) This function is called a *window procedure* and it is often the core of the PM program.

THE WINDOW PROCEDURE Most Presentation Manager programs create a *standard window*. A standard window is actually a collection of smaller windows. This collection comprises a title-bar window, which extends across the top of the standard window and identifies the program; a system menu, located in the upper-left corner; a minimize and maximize menu, in the upper-right corner; and the program's main menu (or action bar), which is located below the title bar. The large interior area of the standard window is occupied by still another window, called the *client window*. Finally, a frame window holds the whole collection of windows together.

A window procedure, or window proc (rhymes with *clock*), is a function that processes messages sent to a window. A window receives a message whenever something happens that affects the window. Although some of the messages a window procedure receives relate to input from the keyboard or mouse, messages encompass much more than user input.

The window procedures for most of the individual windows that make up the program's standard window are located in one of the Presentation Manager's dynamic link libraries. The window procedure for the client window, however, resides in the program that creates the window. Because this window procedure is in your PM program but is called from the PM, it must be defined in a particular way.

> ■ PM programs have a more intimate link with the operating system than do programs written for conventional environments like DOS.

When we speak of a window procedure (for the client or any other window) "receiving messages," what really happens is that the window procedure is called from the Presentation Manager. The parameters of the window procedure identify the message and provide additional information about it. Figure 1 shows the skeleton of a sample window procedure named ClientWndProc.

A SAMPLE PROCEDURE As you can see in Figure 1, a procedure has four parameters. The hwnd parameter is the handle of the window to which the message is being sent. This msg parameter is simply a number (defined as a USHORT, or unsigned short) that identifies the message. The PMWIN.H header file contains identifier definitions for all the messages a window procedure can receive. These identifiers begin with the prefix WM (window message). For example, here's the definition of WM_CREATE:

```
#define WM_CREATE 0x0001
```

A msg value of 1 indicates a WM_CREATE message. Presentation Manager programmers often use a switch-and-case construction to do various tasks for each type of message received by the window procedure.

The ClientWndProc function in Figure 1 processes six messages:
WM_CREATE
WM_SIZE
WM_BUTTON1DOWN
WM_CHAR, WM_PAINT
WM_DESTROY

When a window procedure processes a message, it returns a value to the Presentation Manager code that called it. In most cases the return value is zero. Thus, as you see in Figure 1, the processing of each of the six message ends with a

```
return 0 ;
```

instruction.

All messages that the window procedure does not process must be passed to WinDefWindowProc for default processing. The value returned from WinDefWindowProc must also be returned from the window procedure. This is done at the bottom of ClientWndProc in Figure 1.

A window procedure is an EXPENTRY (exported entry) function. EXPENTRY is defined in OS2DEF.H in this way:

```
#define EXPENTRY pascal far
```

The window procedure has to be a far function, because it is called from a code segment in a dynamic link library that is outside the program's code segment. The window procedure is called with a Pascal calling sequence, which means that the caller pushes the parameters on the stack from left to right.

You'll notice that there are two other data types in Figure 1 that I didn't discuss in the last column. These are MRESULT (message result) and MPARAM (message parameter). Both of these data types are defined in PMWIN.H in the same way:

```
typedef VOID FAR *MPARAM ;
typedef VOID FAR *MRESULT ;
```

Thus, these two data types are generic far pointers.

THE MESSAGE PARAMETERS The two MPARAM parameters of the window procedure are customarily named mp1 (message parameter 1) and mp2 (message parameter 2). For most messages, the message parameters contain information unique to the particular message. How a window procedure uses mp1 and mp2 depends on the message that is being received by the window procedure.

An example may make this clearer. A window procedure receives a WM_CREATE message when the window is first created. This is the first message received by the window procedure, which usually takes this opportunity to perform some initialization.

■ The MPARAM parameters of the window procedure are named mp1 and mp2 (message parameters 1 and 2).

When a window procedure receives a WM_CREATE message, the mp2 parameter is a far pointer to a structure of the CREATESTRUCT type (defined in PMWIN.H). This structure contains information about the window being created—its screen location and size, for example.

Although the two message parameters are defined using the MPARAM type (which is a generic far pointer), for many messages the message parameters are not far pointers. For example, the window procedure receives a WM_SIZE message whenever the size of the window changes. (This is often caused by the user's changing the window size using the keyboard or the mouse.) During a WM_SIZE message, the old size of the window is encoded in mp1. In this case, mp1 is treated as two 16-bit USHORT values. The low USHORT of mp1 is the old width of the window in pixels, and the high USHORT is the old height. The mp2 parameter contains the new dimensions of the window encoded in the same way: the width is the low USHORT of mp2 and the height is the high USHORT.

To take another example, when the user depresses button 1 on the mouse, the window procedure receives a WM_BUTTON1DOWN message. (Button 1 is usually the left button, but left-handed users can change the meaning of the left and right buttons through the Presentation Manager Control Panel program.) The coordinates of the mouse pointer at the time the mouse button was depressed are contained in mp1. The lower 16 bits contain the *x* (horizontal) coordinate, and the upper 16 bits contain the *y* (vertical) coordinate.

A WM_CHAR message occurs when the user presses or releases a key on the keyboard. Five values are encoded in mp1 and mp2. As you can probably guess, one of these values is the ASCII character code of the key being pressed. For noncharacter keys (such as function keys), another value

```
MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg,
 MPARAM mp1, MPARAM mp2)
     {

     [definition of local variablas]

     switch (msg)
          {
          csse WM_CREATE:
                    [...]
               return 0 ;

          casa WM_SIZE:
                    [...]
               return 0 ;

          case WM_BUTTON1DOWN:
                    [...]
               return 0 ;

          csse WM_CHAR:
                    [...]
               raturn 0 ;

          case WM_PAINT:
                    [...]
               raturn 0 ;

          case WM_DESTROY:
                    [...]
               return 0 ;
          }
     raturn WinDefWindowProc (hwnd, msg, mp1, mp2) ;
     }
```

Figure 1: *Virtually every Presentation Manager program contains a window procedure to process messages to a window it creates.*

gives the *virtual key code* of the key. I'll discuss the WM_CHAR message in more detail later in this column.

For some messages, the message parameters are set to NULL (zero). This is the case with WM_PAINT, which a window procedure receives when part of the window must be updated, and WM_DESTROY, generally the last message a window procedure receives.

Historical note: In some of the early beta-test versions of the Presentation Manager, the two message parameters were defined as ULONGs (unsigned long integers) and were called lParam1 and lParam2. Because both a ULONG and a far pointer are 32 bits in length, it doesn't really matter whether you treat them as ULONGs or as far pointers. But it's best to define them as MPARAM's for compatibility with future versions of the Presentation Manager.

Message Parameter Macros

Macro	Extracts	Size (bits)
LONGFROMMP	LONG value	32
SHORT1FROMMP	Low USHORT	16
SHORT2FROMMP	High USHORT	16
CHAR1FROMMP	Low CHAR	8
CHAR2FROMMP	Next highest CHAR	8
CHAR3FROMMP	Next highest CHAR	8
CHAR4FROMMP	High CHAR	8
PVOIDFROMMP	Generic far pointer	32
HWNDFROMMP	Window handle	32

Figure 2: *Presentation Manager macros for extracting information from message parameters.*

EXTRACTING INFORMATION Often, when processing a message, a window procedure must extract information from mp1 and mp2. This information is encoded in different ways for different messages. For some messages (such as WM_SIZE and WM_BUTTON1DOWN), a message parameter contains two USHORTs stuck together. For others, a message parameter is a far pointer. In the case of the WM_CREATE message, it's a pointer to a structure of the type CREATESTRUCT.

■ During the WM_BUTTON1DOWN message, you use casting and C shift operations to extract the mouse pointer position from mp1.

Of course, you can use some normal C casting operations for extracting this information. For example, suppose you need to access the CREATESTRUCT structure during the WM_CREATE message. You first define a local variable of the type PCREATESTRUCT:

```
PCREATESTRUCT pcrst ;
```

within the window procedure. The PCREATESTRUCT type is a far pointer to a structure of the type CREATESTRUCT. During the WM_CREATE message, you use casting to convert mp2 to a PCREATESTRUCT and assign it to the variable `pcrst` thus:

```
case WM_CREATE:
     pcrst = (PCREATESTRUCT) mp2 ;

          [...]
```

For processing the WM_BUTTON1DOWN message, you might define two variables of the type SHORT to hold the coordinates of the mouse pointer:

```
SHORT xMouse, yMouse ;
```

During the WM_BUTTON1DOWN message, you use casting and C shift operations to extract the mouse pointer position from mp1 as follows:

```
case WM_BUTTON1DOWN:
     xMouse = (USHORT) (ULONG) mp1 ;
     yMouse = (USHORT)
              ((ULONG) mp1 >> 16)) ;

          [...]
```

A better alternative, however, is to use macros (defined in the PMWIN.H header files) that are specifically designed for extracting information encoded in the message parameters. These macros are shown in the table of Figure 2.

Another historical note: Back in the days when the message parameters were defined as ULONGs, different macros were available for extracting information: LOUSHORT and HIUSHORT (for extracting USHORTs from a ULONG), and LOUCHAR and HIUCHAR (for extracting the two UCHARs from a USHORT). These macros are still available (defined in OS2DEF.H), and you may still see them used in some Presentation Manager programs.

USING MACROS Let's look at some examples that use these macros when processing messages. As I mentioned earlier, the mp2 parameter that accompanies the WM_SIZE message contains the new width and height of the window. Normally, a program simply saves these two dimensions in static variables and returns from the window procedure. The window procedure would have a couple of local variables defined thus:

```
static USHORT cxClient, cyClient ;
```

And the WM_SIZE message processing would look like this:

```
case WM_SIZE:
     cxClient = SHORT1FROMMP (mp2) ;
     cyClient = SHORT2FROMMP (mp2) ;
     return 0 ;
```

The window procedure then uses cxClient

WM_CHAR Message Parameters

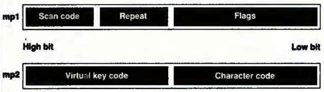


Figure 3: *A diagram showing the information that is encoded in the mp1 and mp2 message parameters that accompany the WM_CHAR message.*

and cyClient when processing subsequent messages.

The processing of a WM_BUTTON1DOWN message usually begins in a similar manner. The window procedure extracts the coordinates of the mouse from mp1 as follows:

```
case WM_BUTTON1DOWN:
     xMouse = SNORT1FROMMP (mp1) ;
     yMouse = SHORT2FROMMP (mp1) ;

          [...]
```

In the WM_CREATE message, mp2 is a far pointer to a structure of the type CREATESTRUCT. If the variable `pcrst` is defined as a PCREATESTRUCT, you can cast the value returned from the PVOIDFROMMP to a PCREATESTRUCT:

```
pcrst = (PCREATESTRUCT) PVOIDFROMMP (mp2) ;
```

(Of course, the PVOIDFROMMP macro is not strictly needed for this job.)

You can dispense with the `pcrst` variable and use the −> operation to access the fields of the structure directly from mp2. For example, one field of the CREATESTRUCT structure is named x and gives the location of the left side of the window relative to the left side of the screen. You can reference this field using

```
((PCREATESTRUCT) PVOIDFROMMP (mp2))->x
```

THE WM_CHAR MESSAGE One of the most complex collections of information accompanies the WM_CHAR message, which signals keyboard input to a Presentation Manager program. Each press and release of a key generates a WM_CHAR message.

Five separate values are stored in mp1 and mp2: the keyboard scan code, the character code, a virtual key code (for noncharacter keys), a repeat count (for typematic repeats), and a series of flags that describe the keystroke (for example, whether or not the key has been pressed or released). The repeat count and the scan code are UCHARs, and the other three values are USHORTs.

■ One of the most complex collections of information accompanies the WM_CHAR message, which signals keyboard input to a Presentation Manager program.

The encoding of information in mp1 and mp2 for the WM_CHAR message is shown diagrammatically in Figure 3. If a window procedure needed all this information, it might begin processing the WM_CHAR message by extracting the values from mp1 and mp2 and storing them in five variables:

```
case WM_CHAR:
     flags = SHORT1FROMMP (mp1) ;
     repeat = CHAR3FROMMP (mp1) ;
     scancode = CHAR4FROMMP (mp1) ;
     charcode = SHORT1FROMMP (mp2) ;
     virtkey = SHORT2FROMMP (mp2) ;

          [...]
```

Of course, it's not easy to remember how this information is encoded in mp1 and mp2. And that's why there's an alternative for the WM_CHAR message.

MORE MACROS TO THE RESCUE The PMWIN.H header file contains a special macro named CHARMSG, which you can use to extract information from mp1 and mp2 during the WM_CHAR message. This macro takes one parameter, a pointer to the msg parameter of the window procedure. Thus, for example, the following expression:

```
CHARMSG(&msg)->fs
```

refers to the flags, the low USHORT of mp1. Similarly, the expressions below are, respectively, the repeat count, the scan code, the character code, and the virtual key code:

```
CHARMSG(&msg)->cRepeat
CHARMSG(&msg)->scancode
CHARMSG(&msg)->chr
CHARMSG(&msg)->vkey
```

The use of the CHARMSG macro adds a little more documentation to your source code and makes it easier to write code for the WM_CHAR message without consulting the PM documentation.

The PMWIN.H header files have two other macros similar to the CHARMSG macro. One is called MOUSEMSG and can be used with all the mouse messages including WM_BUTTON1DOWN. You can use the statement

```
MOUSEMSG(&msg)->x
```

to get the *x*-coordinate of the mouse pointer and

```
MOUSEMSG(&msg)->y
```

to get the *y*-coordinate. The COMMANDMSG macro is used to process WM_COMMAND, WM_SYSCOMMAND, and WM_HELP messages, which usually indicate that a user has selected an item from a menu.

HOW CHARMSG WORKS You may be puzzled by the syntax of the CHARMSG macro. Certainly it looks a little strange. The macro takes a parameter that is a pointer to the variable msg, which is a parameter to the window procedure. The -> operation usually references a field of a structure from a pointer to the structure, so it's a little disconcerting to see it following a macro.

Of course, you don't have to know how the CHARMSG macro works in order to use it. One of the purposes of the header files is to hide ugly details from a program. But let's examine it anyway and see if we can learn some neat tricks.

■ You may be puzzled by the syntax of the CHARMSG macro. Certainly it looks a little strange.

The CHARMSG macro works in conjunction with a structure defined in PMWIN.H with a tag name of _CHARMSG:

```
struct _CHARMSG
     {
     USHORT chr ;
     USHORT vkey ;
     USHORT fs ;
     UCHAR  cRepeat ;
     UCHAR  scancode ;
     } ;
```

You'll notice that the first two fields are the two values encoded in mp2 (the character code and virtual key code), and the last three fields are the values encoded in mp1.

The definition of this structure happens to be based on the memory layout of the program stack when the window procedure is called. The window procedure is called with a Pascal calling sequence, which means that the window handle (hwnd) is pushed on the stack first, followed by msg, mp1, and mp2. Just before the window procedure function is called, the program stack contains the information (from high memory to low memory) shown diagrammatically in Figure 4. Thus, the _CHARMSG structure actually describes the mp1 and mp2 message parameters as they are stored on the stack.

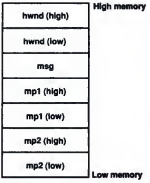
The CHARMSG macro is defined thus:

```
#define CHARMSG(pmsg) \
      ((struct _CHARMSG FAR *) \
      ((PBYTE) pmsg - sizeof \
      (MPARAM) * 2))
```

(We've used the left slashes at the end of each line as continuation characters; they're necessary to fit the entire macro in the column width used in this magazine.)

The CHARMSG macro parameter is a pointer to the msg parameter of the function, so it points to the location on the stack where msg is stored. The macro casts this pointer to a PBYTE (a pointer to a byte) and subtracts twice the size of the MPARAM data type. The pointer then points to the low half of mp2 on the stack. This pointer is then cast to a pointer to a structure of the type _CHARMSG.

Window Procedure Parameter Stack



High memory

hwnd (high)

hwnd (low)

msg

mp1 (high)

mp1 (low)

mp2 (high)

mp2 (low)

Low memory

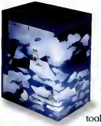
Figure 4: *Window procedure parameters are stored on the stack in the order shown above, from high memory to low memory.*

This means that the expression CHARMSG(&msg) is a pointer to a structure of the type _CHARMSG. Thus, you can reference the fields of the _CHARMSG structure using the C –> operation. That's downright clever.

It's fairly obvious that the CHARMSG macro must be changed for an 80386 version of the Presentation Manager (or for a PM version that runs on another machine altogether). But that's why CHARMSG is defined in the PM header files—you can change the header files while leaving your program untouched.

ADVANCED | REVELATION

This wasn't supposed to happen until the year 2000.



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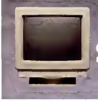

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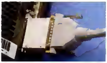

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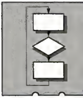

Our series on file management begins by clarifying the terminology and showing the parallels between the basic DOS and OS/2 functions and their equivalents in the C runtime library.

Having finished updating the Power Programming library for OS/2 compatibility and taken a brief look at the DOS and OS/2 file systems, we're moving on to the subject of file management. I'll begin here by reviewing some terminology and the basic file access functions available to assembly language and C programmers under DOS and OS/2. In the next few issues, I'll get into specific techniques for sequential and random file access and indexed file management.

But first, a word to the wise: DOS has two distinct sets of file function calls, which are commonly known as the FCB (File Control Block) functions and the *handle* functions. The FCB functions were designed for compatibility with CP/M; they do not support the hierarchical (treelike) disk structure of DOS Versions 2.0 and later, and are now as much a historical curiosity as the brass cuspidor. The DOS handle functions do support the hierarchical directory structure and have direct counterparts in OS/2. Since right-thinking programmers regard FCBs as a form of heresy, I'll not be mentioning them again.

BASIC FILE OPERATIONS Although both DOS and OS/2 have extensive sets of file-related function calls, the average application program needs only a few of these calls. For the present, I'll ignore the more exotic capabilities of OS/2 and those file functions present only in DOS Version 3.0 or later, and examine the capabilities that every program needs:

- opening and creating files;
- reading and writing;
- seeking; that is, setting the file pointer;
- closing files; and
- renaming or deleting files.

The DOS function calls for these basic operations, together with their OS/2 equivalents, are listed in Figure 1.

To open a file, a program identifies the file to the operating system by name using an ASCIIZ (null-terminated) string, by specifying the access rights it needs (read-only, write-only, or read-write), and by indicating whether it is willing to share simultaneous access to the file with other programs. If the file exists and there is no conflict between the requested access rights and another program's sharing mode, the system returns an identifier—called a *handle*—that the program can use for subsequent access to the file. The handle is an indirect index into a structure known as the System File Table (SFT), which the operating system uses to keep track of all open files in the system.

> ■ Although both DOS and OS/2 have extensive sets of file-related function calls, the average application program needs only a few of them.

When a file is created, the program supplies an ASCIIZ filename and an attribute parameter, which assigns such system characteristics as "hidden" or "read-only" to the file. If the operation is successful, the system adds an entry to the disk directory and again returns a handle that the program can use for subsequent access to the file. An additional open operation is not required and in fact would needlessly expend an additional handle.

The Create function available in DOS Versions 2.*x* (interrupt 21h function 3Ch) must be used with care because if the named file already exists, it is simply replaced (truncated to zero length) and any previous data in the file is lost. Later versions of DOS provide several additional file-creation functions, including both a function that fails if the file already exists and a function that generates a name (based on the current time) for a temporary file. The OS/2 DosOpen function, which is used to open and create files, has a parameter that allows you to tailor the function's actions to the previous existence or nonexistence of the file.

Once a file is opened or created, a program can go to work on its contents. To read data from the disk into RAM, the program supplies the operating system with a buffer address, a number of bytes to read, and a handle. The data on the disk is unchanged, though obviously the previous contents of the specified area of RAM are lost. To write data from RAM onto the disk, the program supplies the same three parameters as for a read operation, but in this case the contents of RAM are unchanged and the previous contents of the disk area are lost. Data is not necessarily transferred physically between the disk and RAM when a program's read or write request "logically" completes; to improve performance, both DOS and OS/2 buffer disk data internally for extended periods.

Both DOS and OS/2 maintain a file pointer in the SFT for each open file handle. When a program issues a read or write request, the current value of the file pointer for that handle determines the byte offset from the start of the file at which the transfer will begin. When the transfer completes, the system updates the file pointer so that it points to the very next byte after the last byte that was read or written.

DOS and OS/2 allow a program to set the file pointer to an arbitrary value. This is often called a seek operation. The function call accepts a 32-bit byte offset and a method code that specifies whether the offset is relative to the start of the file (method 0), to the current file-pointer position (method 1), or to the end of file (method 2). This "logical seek" should not be confused with the physical seek performed by a disk drive, which involves moving the read/write head to a specific cylinder.

DOS and OS/2 File-Management Functions

DOS Int 21h function	OS/2 function	Description
3Ch	DosOpen	Create file
3Dh	DosOpen	Open file
3Fh	DosRead	Read file
40h	DosWrite	Write file
42h	DosChgFilePtr	Set file pointer
3Eh	DosClose	Close file
41h	DosDelete	Delete file
56h	DosMove	Rename or move file

Figure 1: *These are the basic DOS and OS/2 file-management functions.*

The DOS and OS/2 seek functions always *return* a file pointer that is relative to the start of a file. Consequently, there are two special uses of the function. To obtain the current position of the file pointer without modifying it, you can request a seek relative to the current file-pointer position (method 1) with an offset of zero. To find the size of a file, you can call for a seek relative to the end of the file (method 2) with an offset of zero.

A program closes a file to notify the system that it will not be using that file further. The operating system then flushes any unwritten data associated with the file to disk, updates the disk directory (if necessary) to reflect any changes made to the file, and releases the handle and the corresponding entry in the SFT for reuse.

Handles are not involved when a program deletes or renames a file. In these operations the file is identified by an ASCIIZ string, just as for the open and create operations. When a file is deleted, the first character of its entry in the disk directory is changed to a reserved value and the disk sectors previously assigned to the file are freed. The remainder of the directory entry and the contents of the sectors are not altered, however, until they are actually assigned to a new file. This gaping hole in system security has given rise to an entire category of utility software—and to at least a couple of personal fortunes.

C FILE FUNCTIONS The C runtime library contains two distinct, parallel sets of file functions. These are known as the low-level functions and the stream functions. Mixing the use of low-level and stream functions within the same program is almost guaranteed to introduce obscure bugs and lead to novel and picturesque (but not usually desirable) program behavior.

The low-level file functions map directly onto the host operating system's file interface, use the handles provided by the system, and do not buffer or translate data as it is read or written. You would select the low-level functions when you want to minimize runtime library overhead, perform I/O to unusual devices, or to take advantage of unusual capabilities or characteristics of the host system.

The stream functions rely on a C data structure to control each open file. They use the address of this structure rather than a handle to reference the file for read or write operations. The stream functions buffer the file data within the runtime library (in addition to the buffering already provided within the operating system itself) and, under some circumstances, these functions translate characters within the data. Select the stream functions to maximize the portability of your program or when your program has complex data-formatting requirements.

C Runtime Library File-Management Functions

Low-level function	Stream function	Description
creat	fopen	Create file
open	fopen	Open file
read	fread	Read file
write	fwrite	Write file
lseek	fseek	Set file pointer
close	fclose	Close file
unlink	unlink	Delete file
rename	rename	Rename file

Figure 2: *Here are the basic file-management functions contained in the C runtime library.*

Figure 2 lists the most commonly used low-level and stream functions, and the library functions for deleting and renaming files. Most of the 50-odd file-related library functions that are not listed here are related to such matters as redirection of handles, formatted input, formatted output, temporary files, and control of stream buffering. I'll discuss many of these other functions in upcoming columns.

While browsing through Figure 2 and your C compiler's runtime library manual, you may be struck by the strong resemblance between the C library functions and the DOS and OS/2 file function calls. The points of resemblance range from the glaringly obvious—such as the use of ASCIIZ strings to identify files—to more subtle issues. For example, the method codes used by `lseek()` are exactly the same as those used by the DOS and OS/2 function calls for setting the file pointer position. This congruence is not coincidence! The handle file functions in DOS and OS/2 were patterned after those in Unix; similarly, the C runtime library's file management functions are designed around the Unix file system and vice versa.

RECORD ACCESSING TERMS Three terms that may come up in discussions of file management are *records*, *sequential access*, and *random access*. Although the operating system sees a file simply as a named collection of bytes, programmers think of the file as being composed of one or more records. Each *record* describes a particular person or object; it may be compounded of many fields of different types and is usually an integral number of bytes in length. The key features of a record—for our purposes—are that it has a predictable structure and that its length either is a constant (for a given file) or somehow encoded in the record.

Sequential access means reading or writing consecutive records in a file. An example is the processing of a text file, in which each line can be considered a record delimited by a new-line character. A program that processes files sequentially need not concern itself with the file pointer because that is maintained by DOS or OS/2.

Random access means reading and writing nonsequential records. That is, the physical ordering of the records in the file does not determine the order in which they are processed. (The term is not very apt because, of course, the processing is not at all random.) In simple programs, random access is typically used with files that contain fixed-length records, so that the program can calculate the location of a specific record by multiplying the record number by the record size. The indexed-file access methods used by more-sophisticated applications are much more versatile.

Both DOS and OS/2 draw little distinction between sequential and random access. When a file is opened or created, its file pointer is initially set to zero. If a process simply issues reads or writes without ever setting the file pointer position, then its access to the file is sequential. If a process requires random access, it need only position the file pointer appropriately before each read or write request. Naturally, these techniques can be used together.

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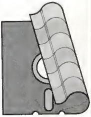


Two macros that work together to allow you to save your cell pointer's current position, save the cell's address in the leftmost column, and return the cell pointer to its original position.

Macros that return the same part of a worksheet to the screen that was previously visible

In the August 1988 Spreadsheet Clinic, you presented a set of two macros. The first saved the cell pointer's current position as well as the cell's address in the column at the left edge of the screen. The second macro returned the same columns to the screen that were previously visible, and then returned the cell pointer to the cell on which it was positioned.

I've improved these macros, as shown in Figure 1. The macro named \s saves the cell pointer's current position, the column component of the leftmost column that is visible on the screen, and the row component of the topmost column that is visible on the screen.

To determine which column is at the left edge of the screen, I use the same technique that you did in your macros. To determine which row is at the top of the screen, I take advantage of the special action of the PgDn key when one or more title rows are locked onto the screen.

The first statement in the macro named \s freezes the window and panel areas of the screen. The second clears any titles that you may have set previously. Then it "freezes" all the rows that are visible (on the screen) above the one in which the cell pointer is positioned at the time. For example, if rows 21 through 40 are visible on the screen and the cell pointer is in row 25, *1-2-3* will freeze rows 21 through 24 onto the screen.

The third command enters the absolute address of the current cell into CURRENTCELL (cell B10). For example, if the cell pointer was on cell L25 when you invoked this macro, *1-2-3* would enter the label 'L25 into CURRENTCELL.

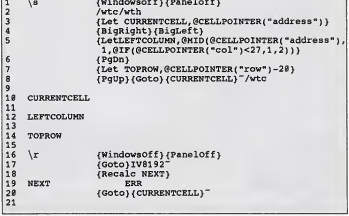
The next statement moves the cell pointer left within the current row into the leftmost column that was visible on the screen when you invoked the macro. For example, if cells I21..P40 were visible on the screen when you invoked the macro and the cell pointer was on cell L25, *1-2-3* would move the cell pointer to cell I25.

Then *1-2-3* executes the following:

```
B5:  '{Let LEFTCOLUMN,
     @MID(@CELLPOINTER("address"),1,
      @IF(@CELLPOINTER("col")<27,1,2))}
```

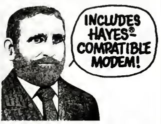
in cell B5. This enters the column letter(s) of the current cell (the one in the leftmost column that is visible on the screen) into the cell named LEFTCOLUMN (B12). For example, if the cell pointer was on cell I25, *1-2-3* would enter the label 'I into LEFTCOLUMN.

The sixth command instructs *1-2-3* to press the PgDn key. Since one or more title rows are frozen onto the screen, *1-2-3*



```
          A              B        C         D        E        F
1    \s             {Windowsoff}{Paneloff}
2                   /wtc/wth
3                   {Let CURRENTCELL,@CELLPOINTER("address")}
4                   {BigRight}{BigLeft}
5                   {LetLEFTCOLUMN,@MID(@CELLPOINTER("address"),
                     1,@IF(@CELLPOINTER("col")<27,1,2))}
6                   {PgDn}
7                   {Let TOPROW,@CELLPOINTER("row")-20}
8                   {PgUp}{Goto}{CURRENTCELL}~/wtc
9
10   CURRENTCELL
11
12   LEFTCOLUMN
13
14   TOPROW
15
16   \r             {WindowsOff}{PanelOff}
17                  {Goto}IV8192~
18                  {Recalc NEXT}
19   NEXT                 ERR
20                  {Goto}{CURRENTCELL}~
21
```

Figure 1: *The macro named \s saves the address of the current cell as well as the column letter and row number of the cell at the upper-left corner of the screen; the macro named \r returns the portion of the worksheet to the screen that was visible previously.*



won't bring a whole new screenful of rows into view. Instead, it will shift only the non-title rows. Consequently, the cell pointer will end up in the row that previously was immediately below the bottom of the screen. For example, if rows 21 through 40 are visible on the screen, and rows 21 through 24 are title rows, *1-2-3* won't bring rows 41 through 60 onto the screen. Instead, it will replace rows 25 through 40 with rows 41 through 56. Now the cell pointer will be in row 41.

While the cell pointer is in this new row, *1-2-3* will execute

```
B7:  '{Let TOPROW,
     @CELLPOINTER("row")-20}
```

in cell B7, which enters the address of the row that was at the top of the screen when you invoked the macro—the row 20 rows above the current row—into the cell named TOPROW (B14). If rows 21 through 40 were visible on the screen when you invoked the macro, the cell pointer will be in row 41 at this point.

■ The first statement in the macro freezes the window and panel areas of the screen.

Thus, *1-2-3* will enter the value 41−20=21—the row number of the row at the top of the screen—into TOPROW.

The final statement in this macro returns the same rows and columns to the screen that were visible before you invoked the macro, moves the cell pointer back to the cell on which it was positioned at that time, and unlocks the title rows.

The macro named \r brings the same rows and columns onto the screen that were visible when you invoked the macro named \s, and moves the cell pointer back to the cell on which it was positioned.

The first statement freezes the window and panel areas of the screen. The second moves the cell pointer to cell IV8192—the lower-right corner of the worksheet.

The next command instructs *1-2-3* to recalculate the string formula

```
B19:  +"{Goto}"&@LEFTCOLUMN
           &@STRING(TOPROW,0)&"~"
```

in the cell named NEXT (cell B19). This formula returns a macro statement that commands *1-2-3* to move the cell pointer to the cell that was at the upper-left corner of the screen when you invoked the macro named \s. For example, if cells I21..P40 were on the screen when you invoked the \s macro, LEFTCOLUMN would contain the label 'I at this point, and TOPROW would contain the value 21. Therefore, this formula would return the statement {Goto}I21~, which commands *1-2-3* to move the cell pointer to cell I21.

Because the cell pointer will be on cell IV8192 when *1-2-3* executes this statement, the cell to which *1-2-3* moves the cell pointer will be the upper-left corner of the screen. So the same row and columns will be visible on the screen that were visible when you invoked the \s macro. Once these rows and columns are in view, *1-2-3* will execute the final statement in the macro, which moves the cell pointer to the cell on which it was positioned when you invoked the first macro.—*Tom Kusnierz; Groton, Connecticut*

The PgDn and PgUp keys, when one or more title rows are locked onto the screen, let you calculate the row number at the top of the screen at any point. The value 20 in the statement in cell B7 assumes that you are working in a window that is 20 rows tall. If you're working in a window with more or less than 20 rows, adjust that value accordingly. If you had set any title rows or columns before invoking the \s macro, reset them afterwards.

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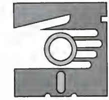
■ **NEIL J. RUBENKING**



USER-TO-USER

A batch file that acts like TYPE and works with wildcards; an automatic way to keep track of your boot time; using the FOR command to compare two lists of files.

Advanced use of the FOR command lets you compare groups of files

The powerful FOR command came to my rescue when I encountered *SuperCalc*'s inability to check for file existence. My program was to update a list of current files, working from CSV (comma-separated values) files downloaded from a minicomputer. The problem occurred when the minicomputer created a new filename that had never been used before, or when it didn't send an existing file because it was no longer needed. In short, I needed to compare two lists of files (same names, different extensions) and make them match.

First, if the minicomputer created a new .CSV file, I copied a blank template to the other list so it had a corresponding "old" file. If there was an old file with no matching .CSV file, I deleted it.

Next I deleted any old files that were no longer needed (those that did not have a corresponding .CSV file). Then I removed the extension from the old files and combined the FOR and IF commands to erase any that were no longer needed. (The list of *.CSV files is assumed correct.)

I restored the extensions of the "old" files and renamed the new .CSV files with no extension. I copied in my blank template file, FILE.TMP, to create an "old" file for any new .CSV files created by the minicomputer.

The final step was to replace the .CSV extensions. I combined everything into a batch file, as shown in Figure 1, along with the necessary directory changes, user messages, and calls to SuperCalc.—*Greg Jensen; Port Coquitlam, British Columbia, Canada*

I simplified FILMATCH.BAT in Figure 1, removing lines specific to the original application and leaving only those demonstrating the file-matching concept. When you want to use a FOR command to compare files that match in name but differ in extension, you have a bit of a problem. There's no way to separate the name and extension in the FOR variable. Jensen hit on the idea of simply REMOVING the extension from one set of files temporarily. This works, as long as you don't have any other files around with no extensions.

Note that you can use the FOR command from the DOS prompt too. You just have to remember to put only one percent sign in the FOR variable. For example, to list any files in the current directory that already exist in the directory C:\OTHER, you would enter

```
FOR %f IN (*.*) DO IF EXIST C:\OTHER\%f
 ECHO %f
```

This command goes through all files matching *.* and assigns each in turn to the variable %f. Then it expands the command after the DO using the value of %f. For example, if the first file is AUTOEXEC.BAT, the DO command would expand to

```
... IF EXIST C:\OTHER\AUTOEXEC.BAT
 ECHO AUTOEXEC.BAT
```

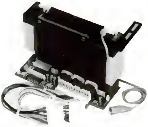
You might also use this technique to clean up duplicates by deleting files that appear in another directory as well. However, it compares *only* the name, not the contents.

Who's booting your PC? Here's an automatic way to log every time it's fired up

Is your PC in a public place where it could get unauthorized use? Or maybe you would like to maintain a log of your bootups? Here's a simple way to log every time

```
ECHO OFF
REM The next two lines delete any OLD files that don't
REM have a matching CSV file.
RENAME *.OLD *.
FOR %%h IN (*.) DO IF NOT EXIST %%h.CSV ERASE %%h
REM Restore the OLD extension to the old files and
REM remove the extension from the CSV files.
RENAME *. *.OLD
RENAME *.CSV *.
REM For any CSV file that doesn't have a corresponding OLD
REM file, create one by copying a blank template.
FOR %%h IN (*.) DO IF NOT EXIST %%h.OLD COPY FILE.TMP %%h.OLD
RENAME *. *.CSV
```

Figure 1: *This batch file makes one file list match another, adding and deleting as required.*



■ USER-TO-USER

your personal computer gets booted.

Place the small routine in Figure 2 at the beginning of your AUTOEXEC.BAT file. This batch file first sets the prompt to show just the date and time. Then it appends the prompt to BOOTUP.LOG by running DUMMY.BAT, a zero-length batch file. COMMAND /C allows DUMMY.BAT to be nested within LOGGINGS.BAT. The double redirection sign (>>) appends the data to the end of the log file, so it maintains a continuous list. Now each time your AUTOEXEC.BAT is executed, it will write the date and time to the end of the BOOTUP.LOG file. To see when your PC was booted, just look at the BOOTUP.LOG file.

The only way anyone can avoid this routine is by hitting Ctrl-C *very* quickly, or else by booting up with floppy disk. If the BOOTUP.LOG file is placed in some obscure subdirectory it would be very difficult for anyone to tell that the data has been recorded except by examining the AUTOEXEC.BAT file. You must load a clock driver before you run this program so that it uses the correct time.—*Scott A. Evans; Iowa City, Iowa*

■ You must load a clock driver before you run BOOTUP.LOG so that it uses the correct time.

There are a couple of things you can do to make this routine more bulletproof. First, you can make it almost impossible to break out of. Second, you can hide the file itself.

The logging portion of the batch file should completely ignore the keyboard while it's executing. Fortunately, DOS has a command that will do just that: "CTTY NUL". This command tells DOS to get its input from the NUL device and write any output to the NUL device—it's out of touch. Your batch file *must* eventually include the line CTTY CON, telling DOS to get input from the keyboard and write output to the screen. If it doesn't, your computer will remain incommunicado until you reboot. Ctrl-Break will still stop your batch file in CTTY NUL mode, but the only thing to do then is reboot.

```
ECHO OFF
PROMPT $D $T
COMMAND /C DUMMY.BAT >> C:\BOOTUP.LOG
PROMPT
```

Figure 2: *Keep track of each time your computer is booted by adding LOGGINGS .BAT to your AUTOEXEC.BAT file.*

```
@ECHO OFF
CTTY NUL
PROMPT $D $T
TYPE NOTHING.BAT > NOTHING.BAT
COMMAND /C NOTHING.BAT >> C:\BOOTUP.LOG
DEL NOTHING.BAT
PROMPT
CTTY CON
```

Figure 3: *LOGGING2.BAT is a more-sophisticated way to log each time someone boots up your computer.*

Figure 3 is a modified version of LOGGINGS.BAT (Figure 2). It uses CTTY NUL to hide its activity, and it uses the @ symbol of DOS 3.3 to hide the ECHO OFF command. Also, it doesn't depend on finding the zero-length DUMMY.BAT. Instead, it creates its own zero-length file and then deletes it.

But even if you put the code in Figure 3 at the start of your AUTOEXEC.BAT file, someone can still find and modify it. How do you hide something that's in AUTOEXEC.BAT? The answer is, you don't. Instead, you patch your COMMAND.COM to run a file *other* than AUTOEXEC.BAT upon boot-up. You have to be somewhat adept with DEBUG to make a patch like this. So if you don't already have the ability, you probably shouldn't patch COMMAND.COM.

However, if you feel confident, locate the string "AUTOEXEC.BAT" in COMMAND.COM and enter *any* other filename, preferably one that nobody would accidentally use. "QQQQQQQQ.QQQ" is perfectly acceptable. It doesn't have to have the .BAT extension.

Copy LOGGING2.BAT (Figure 3) to the filename you chose, and add the line "AUTOEXEC" at the very end. Use a utility like *PC Magazine*'s ATTR.COM (available on PC MagNet) to hide the file.

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And put the log file in a distant subdirectory, perhaps even a hidden one. ATTR works fine on subdirectories. A hidden subdirectory won't appear in the directory of its parent, but you can access its files normally *if* you know the full pathname.

When your computer boots, it won't be at all obvious that you're logging the event. You can also use this technique to hide other boot-up actions, such as loading an antivirus program.

Here's a batch file that acts like TYPE but works with wildcards

I've often thought it would be handy if the DOS command TYPE accepted wildcards, so that TYPE *.BAT would show you the contents of all of the batch files in a given directory. But it won't, so I wrote LOOKAT.BAT—a one-line batch file that takes advantage of DOS's ability to copy to character devices:

```
COPY %1 CON
```

It acts like TYPE but it accepts wildcards. Typing LOOKAT *.BAT copies your batch files to the console and puts them on the screen, just as the TYPE command does. And, as an added bonus, because the COPY command shows the name of each file while copying it, LOOKAT.BAT precedes each file with its name.—*Bob DuCharme; New York, New York*

LOOKAT isn't *quite* the same as TYPE. TYPE can redirect the output. Thus,

```
TYPE FILENAME | MORE
```

will type the filename with pauses at the end of each screenful. The command

```
TYPE FILENAME > PRN
```

will print the file. You can't do this with LOOKAT. But LOOKAT will certainly give you a quick look at the files you've requested, and you can pause the output with Ctrl-S or Ctrl-NumLock.

The FOR command also lets you run DOS commands on multiple files. For example, at the DOS prompt, the command

```
FOR %f IN (*.BAT) DO TYPE %f
```

will type all the files matching a template.

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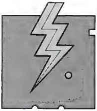

POWER USER

Output compressed type on your LaserJet even with programs that don't support it; customize WordPerfect 5.0 for different individual SETUPs.

WordPerfect's macro caching system seems like a bug until you know how it works

I've discovered a bug in *WordPerfect*, Version 4.2. If you change subdirectories using the List Files function, *WordPerfect* doesn't change the internal default subdirectory it uses when calling macros. You might, for example, invoke a macro called COPY in the current directory and then change to another directory that contains a different macro called COPY. If you now invoke the macro COPY, you'll get the *first* one you had called, not the one in your now-current directory.

One solution is to exit *WordPerfect*, change the current subdirectory, and reload the program. Another way is to use unique names for all macros. Still a third is to type in the full path to the macro each time you execute one. None of these solutions seems acceptable.*—Charles C. Schelberg, Jr.; Milford, New Hampshire*

Fortunately, there is no "internal default directory used when calling macros," and what Mr. Schelberg has observed is definitely not a bug. Rather, it's a feature of the way macros work in *WordPerfect*, including Version 5.0.

When you invoke a macro, *WordPerfect* "caches" it in memory. That way, the next time you invoke the same macro, *WordPerfect* doesn't have to read it again from the disk. This saves time, especially when you're using looping macros that call themselves repeatedly.

The macro caching feature *does* create problems if you change directories and want to use same-named macros in the new directory. You don't have to exit *WordPerfect*, though. It's enough to use Ctrl-F1 and exit to DOS temporarily. Type "exit" immediately at the DOS prompt and you're back in *WordPerfect* with no macros cached.*—Neil J. Rubenking*

WordPerfect 5.0 makes it easy to print footnotes in a different font

The footnotes in a *WordPerfect* document normally print in the same font size as the text. It's often desirable to have the notes print in a smaller font, however, particularly if you are trying to use the desktop publishing capabilities of *WordPerfect*, Version 5.0. One way of doing this is to place font change codes in every footnote, shifting into and out of a smaller font. This seemed to me a difficult way to accomplish a simple task. Quite by accident, I discovered an easier method of doing the same thing.

At the beginning of the document insert a footnote options code and surround it with font change codes that switch in and out of the smaller font. For example, Ctrl-F8ss (size small) inserts [SMALL][small] codes in your document. Then Ctrl-F7fo (footnote options) puts you in the footnote options menu. You don't even have to select or change any options. Hit F7 (exit) from the options menu to put a [Ftn Opt] code in your document (with the default options if you've made no changes). Any footnotes created in the document after the footnote options code will appear in whatever font you placed in the document immediately before the options code. Text will appear in the base font or whatever other font you selected after the options code.*—Allen K. Easley; Topeka, Kansas*

■ When you invoke a macro, *WordPerfect* "caches" it in memory. So, the next time you call that macro, *WordPerfect* doesn't reread the disk.

You can put other font changes around the footnote options code to achieve similar effects. For example, you might switch to 17-pitch condensed before the options code and back to 10-pitch NLQ (near letter quality) afterward.

If you change the Base Font for your document and find that the footnotes have not changed, you may have used this feature without meaning to. Look for a footnote options ([Ftn Opt]) code in your document before the font change code. The solution is simple: move the footnote options code so it comes after the font change.*—Neil J. Rubenking*

How to invoke compressed type on the LaserJet even with programs that don't support it

Too many existing programs—especially in the accounting field—do not have a built-in ability to print with compressed type on a LaserJet Plus or Series II. Here are two work-arounds for the problem.

If your program lets you enter a five-character printer setup string to activate compressed type, you can use HP's Font Pitch (Alternate Method) command. To select the line printer font, you would enter

```
<Esc>&k2S
```

or, if the program needs to express commands in decimal ASCII values, use

```
027 038 107 050 083
```

To switch back to 10 pitch,

```
<Esc>&k0S
```

or the analogous command

```
027 038 107 048 083
```

in decimal ASCII.

If a five-character setup string is too long for your program, invoke the LaserJet's secondary font feature. The LaserJet lets you specify two default fonts—primary and secondary—then toggle between them with a single character.

The first step is to set up your printer before you start the application program. In general, you will want the primary font to be the 10-pitch Courier. This is the power-on default in most cases, so you will probably be able to leave that alone. To set the Line Printer font as your secondary default font, you need to send the following command to the printer:

```
<Esc>)s16.6H
```

Note that the parenthesis is a "close parens." This is what makes the command apply to the secondary font.

Sending this command to your LaserJet may present a minor problem since you cannot enter an escape character from the keyboard in DOS. The easiest method is to create a very short file that consists of the command string, with *XyWrite* or a similar word processor that allows you to enter the escape character, and then use the DOS COPY command to send the file to your printer.

Once the secondary font has been defined with this command, you can use the Shift Out code (Ctrl-N, or ASCII 014) to select the secondary font (line printer), and Shift In (Ctrl-O, or ASCII 015) to switch back to the primary font.—*Alfred Poor; Perkasie, Pennsylvania*

Many text editors let you enter the escape character, typically by holding down the Alt key, typing 27 at the numeric keypad, and releasing the Alt key. Others—including the *SideKick* notepad—let you create the escape character by typing Ctrl-P<Esc>. Be sure to save the file in nondocument mode, or without formatting, or whatever your word processor needs to produce a pure ASCII file.

Once you've created the printer command file, you'll avoid a great deal of frustration if you copy it to the printer automatically every time you load the application program by using a suitable batch file. If you've named your command file FONTCOM, the batch file takes the form:

```
COPY FONTCOM PRN
PROGRAMNAME
```

You may also want to create a second file with the command:

```
<Esc>E
```

This RESET file resets the LaserJet to its default settings. In that case, the batch file will take the form:

```
COPY RESET PRN
COPY FONTCOM PRN
PROGRAMNAME
COPY RESET PRN
```

This automatically sets the printer to a known state (its default settings) at the start, sets the secondary font, runs the application program, and then resets the LaserJet to its default settings when you leave the program.—*M. David Stone*

Here's how to customize *WordPerfect* 5.0 for different individual SETUPs

When you change the defaults and preferences for *WordPerfect*, Version 5.0, ini-

```
ECHO OFF
IF "%1"=="" GOTO NOPREF
IF EXIST C:\WP\WP{WP}.%1 GOTO CONTINUE
ECHO Running WP5 and CREATING preference file WP{WP}.%1
ECHO Press any key to continue, or Ctrl-Break to abort.
PAUSE > NUL
GOTO NOPREF
:CONTINUE
ECHO Now running WP5 w/ preference file WP{WP}.%1.
COPY C:\WP\WP{WP}.%1 C:\WP\WP{WP}.SET
:NOPREF
WP
IF "%1"=="" GOTO END
COPY C:\WP\WP{WP}.SET C:\WP\WP{WP}.%1
:END
```

Figure 1: *This batch file will bring up* WordPerfect *5.0 using the setup file of your choice.*

tialization, the only file that changes is WP{WP}.SET. This led me to try an approach that I have been using with *Easy Extra* and *Ventura Publisher*. By copying the "preference" file and allowing each user (or each situation) to have a unique set of preferences, you can accommodate the different needs of several users who must share the same computer.

The key is to use a batch file to copy each desired preference file to the filename *WordPerfect* will use for its setup. To allow for changes while using the program, you copy it back out when exiting from the program. For example, to select the business preference file you might use something like

```
COPY WP{WP}.BUS WP{WP}.SET
WP
COPY WP{WP}.SET WP{WP}.BUS
```

You'll want to modify the above to reflect your own paths and default directories.

This approach can also be used with programs such as *Ventura Publisher*, which always reenter with the same setup that you had when you quit the program. It will not work with *WordPerfect* 4.2 or *WordStar*, which actually modify the .EXE file when you change the start-up parameters with WP/S or WS-CHANGE.—*Michael D. Reilly; Golden, Colorado*

Just press Shift-F1 and poke around in the menu to see all of the different things you can adjust in SETUP. One person may prefer a speedy cursor, another may want timed backup, while a third will insist on a special set of display colors. Each needs a personal WP{WP}.SET file.

Why not identify your different *WordPerfect* preference files with three-letter extensions? Use abbreviations like HOM and BUS for home and business, respectively, or use initials if the files are for different people in the office. The batch file in Figure 1 will run *WordPerfect* using the preference file of choice: just enter, for example, `WPPREF NJR` on the command line. Again, you'll have to modify it to reflect your own directory structure.

WPPREF.BAT will also *create* preference files for you. Just invoke it with a previously unused three-letter extension and wait until it brings up *WordPerfect*. Make any changes you like and then exit *WordPerfect*. It will then copy the changed setup to a new preference file. Of course, you will need to change "C:\WP" to the actual directory *WordPerfect* uses on your system.—*Neil J. Rubenking*

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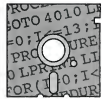
■ **EDITED BY ROBERT L. HUMMEL**



LANGUAGES

Dial your phone with a BASIC program and your modem; substitute Turbo Pascal WAIT for DELAY when working with time-slicing operating systems; interpret function keys in BASIC.

The new Turbo Pascal FSearch function renders our handwritten Exists functions obsolete

Every Turbo Pascal programmer has either written or borrowed a function to determine whether a given filename exists. It usually winds up looking like the Exists function in the program in Figure 1. To see if a file exists, it attempts to open it and see if there's an error. It certainly works, but that method is now obsolete.

Turbo Pascal 5.0 introduces the FSearch function, which searches a semicolon-delimited list of directories and returns the first file matching the input filename. It always checks the current directory before checking the path list. And it returns a null string if the file isn't found. So if FSearch(filename,' ') returns a null string, the file doesn't exist.

In informal speed comparisons, I found FSearch slightly slower than Exists on a very fast hard disk, equal in speed on a moderate-speed hard disk, and *much* faster on a floppy disk. Run the program NEWEXIST on your own disks to get your own comparisons. Using FSearch gains you code space, too. I cobbled up a minimum program using Exists and another using FSearch—the latter was almost 1K smaller. From now on, I am going to use FSearch.—*Neil J. Rubenking*

Interpret function keys in BASIC using a novel table-lookup function

Most BASIC programs want to take advantage of function keys as well as normal ASCII characters. The problem for the programmer is deciphering the extended scan codes that are returned by the INKEY$ function.

```
PROGRAM NewExist;
USES DOS;
CONST Reps = 100;
VAR
  start, total, N, IfTime : LongInt;
  example                 : PathStr;

  FUNCTION time100ths : LongInt;
  VAR H,M,S,F : Word;
  BEGIN
    GetTime(H,M,S,F);
    Time100ths := (((((LongInt(H)*60)+M)*60)+S)*100)+F;
  END;

  FUNCTION Exists(Name : PathStr) : Boolean;
  VAR F : File;
  BEGIN
    Assign(F,Name);
    {$I-} Reset(F); {$I+}
    IF IOresult = 0 THEN
      BEGIN
        close(F);
        Exists := TRUE;
      END
    ELSE Exists := FALSE;
  END;

  PROCEDURE Announce(method, kind : String);
  BEGIN
    WriteLn(reps,' repetitions of ',method,' with ',kind,' file.');
  END;

  PROCEDURE Report(T : LongInt);
  BEGIN
    WriteLn('That took ',T div 100,'.',T mod 100,' seconds.');
  END;

BEGIN
(*Time a minimal IF loop*)
start := time100ths;
FOR N := 1 to reps DO IF TRUE THEN;
IfTime := time100ths - start;
(*Try example files on floppy disks and on hard disks.*)
example := 'NEWEXIST.PAS';

Announce('Exists','existing');
start := time100ths;
FOR N := 1 to reps DO
  IF NOT Exists(example) THEN;
total := time100ths - start - IfTime;
Report(total);

Announce('FSearch','existing');
start := time100ths;
FOR N := 1 to reps DO
  IF FSearch(example,'') = '' THEN;
total := time100ths - start - IfTime;
Report(total);
example := 'QWERTYUI.OP';

Announce('Exists','non-existing');
start := time100ths;
FOR N := 1 to reps DO
  IF Exists(example) THEN;
  total := time100ths - start - IfTime;
  Report(total);

  Announce('FSearch','non-existing');
  start := time100ths;
  FOR N := 1 to reps DO
    IF FSearch(example,'') <> '' THEN;
  total := time100ths - start - IfTime;
  Report(total);
  WriteLn;
  ReadLn;
END.
```

Figure 1: *The new Turbo Pascal FSearch function can be used to test for file existence.*

■ LANGUAGES

To solve this problem, I wrote the GetFKey function shown in Figure 2. This function uses a more sensible method to indicate which key was pressed. The GetFKey routine waits until one of the function keys has been pressed, and then returns a number between 1 and 40 that indicates which key has been pressed. The numerical values correspond to the keys as shown in the table in Figure 3.—*Matthew L. Donovan; Lemoyne, Pennsylvania*

```
Table$ = ";<=>?@ABCDTUVWXYZ[\]^_`abcdefghijklmnopq"

DEF FnGetFKey%
  Code% = 0
  DO
    K$ = INKEY$
    IF LEN(K$) = 2 THEN
      K$ = RIGHT$(K$, 1)
      Code% = INSTR(Table$, K$)
    END IF
  LOOP WHILE Code% = 0
  FnGetFKey% = Code%
END DEF
```

Figure 2: *The GetFKey function is a user-defined BASIC function that translates the scan codes that are returned by the function keys into a logical format.*

The original GetFKey routine was designed as a callable subprogram. I simplified it by eliminating some unnecessary code and changed it to a user-defined function. Though the INSTR function is intended to report the position where a string occurs within another, it is equally valuable when used as a general-purpose table lookup function. In this case, each numeric scan code is associated with a character in a string. Then, INSTR is used both to determine if the code is one of those recognized, and if so, which one.

Because this is a DEF FN type function, QuickBASIC requires that you define it before you define program statements that use GetFKey. Turbo Basic is more forgiving in that the function may be placed anywhere in the source text.
—*Ethan Winer*

GetFKey Function Return Values

Function Key	Key	Shift	Ctrl	Alt
F1	1	11	21	31
F2	2	12	22	32
F3	3	13	23	33
F4	4	14	24	34
F5	5	15	25	35
F6	6	16	26	36
F7	7	17	27	37
F8	8	18	28	38
F9	9	19	29	39
F10	10	20	30	40

Figure 3: *Rather than making you interpret scan codes, the GetFKey function shown in Figure 2 simplifies dealing with the function keys by returning logical values that are listed in the table above.*

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WAIT works better with time-slicing operating systems

The built-in Turbo Pascal DELAY procedure is useful when a programmer wishes to suspend execution. For example, the instruction DELAY(100) creates a delay of approximately 100 milliseconds. The actual delay varies considerably, depending on the machine. In programming situations where more-accurate delays are needed, the procedure WAIT, shown in Figure 4, can be used. The routine is precise to about 1/18 second and is called with a real parameter, which is more convenient than the milliseconds required by DELAY. A typical call would be of the form Wait(Seconds), where seconds is a real constant or a variable of the type real.

The procedure needs to be more complex than is at first apparent, because of the possibility of the clock turning over (reaching midnight) while the routine is active.—*John P. Russo; Granger, Indiana*

The initialization code of a Turbo Pascal program actually times the CPU it's running on and calculates how many empty loops take one millisecond. When you call DELAY, it just sits in an empty loop for the proper number of cycles.

However, time-slicing program managers such as *DESQview*, *Windows*, or *VM/386* can wreak havoc on DELAY. First, the initial timing of the loop value can be wildly different depending on whether or not a time-slice occurs in the

```
(*****************    W A I T   ************************
* Delays NumberOfSecs seconds.  This is done by         *
* accessing the PC clock via function $2C of DOS int    *
* 21h.  Its accuracy is limited by the fact that the    *
* time is calculated from the ROM BIOS tick count,      *
* which is updated only about 18.2 times per second.    *
* This means that Wait will be accurate to about        *
* 1/18 second.                                          *
*                                                       *
* Requires "Uses DOS" if in TP4 or TP5                  *
*****************    W A I T   ************************)

 PROCEDURE Wait(NumberOfSecs : Real);
 CONST
   Secs_PER_DAY = 86400.0; {60 * 60 * 24}
 VAR
   TimeIsUp : Boolean;
   StartingSecs,
   Secs : Real;

   (******************   READ CLOCK  ***********************
   *                                                       *
   *  Reads the PC clock, by using service $2C of int 21h. *
   *  This service returns information in the 8086         *
   *  registers as follows:                                *
   *                                                       *
   *    CH     Hour                    (0 through 23)      *
   *    CL     Minute                  (0 through 59)      *
   *    DH     Seconds                 (0 through 59)      *
   *    DL     Hundredths of seconds   (0 through 99)      *
   ******************   READ CLOCK  ***********************)

   PROCEDURE ReadClock(VAR Secs : Real);

   CONST
     Secs_PER_HOUR = 3600.0; {This must be a real constant!}
     Secs_PER_MINUTE = 60.0;
   TYPE {Delete this type for TP4 and TP5}
     Registers = RECORD
       CASE Boolean OF
         True : (AL,AH,BL,BH,CL,CH,DL,DH:Byte);
         False : (AX,BX,CX,DX,BP,SI,DI,DS,ES,Flags:Integer)
       END;
   VAR Register : Registers;
   BEGIN
     Register.AH := $2C;
     msDos(Register);
     Secs := Secs_PER_HOUR*(Register.CH)
             +Secs_PER_MINUTE*(Register.CL)
             +Register.DH
             +0.01*Register.DL;
   END;

(********************** BODY OF WAIT ***********************)

  BEGIN
    ReadClock(StartingSecs);
    REPEAT
      ReadClock(Secs);      IF Secs-StartingSecs >= 0.0 THEN {Normal situation.}
        TimeIsUp := Secs-StartingSecs >= NumberOfSecs
      ELSE {During call, clock has ticked past midnight.}
        TimeIsUp := Secs_PER_DAY-StartingSecs+Secs >= NumberOfSecs
    UNTIL TimeIsUp
  END;
  BEGIN
  END.
```

Figure 4: *Use WAIT instead of DELAY to make your programs time-sliceable.*

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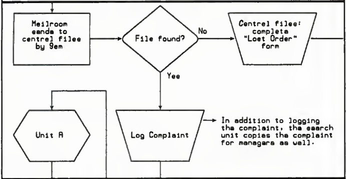
Mailroom sends to central files by 9am
File found?
No
Central files: complete "Lost Order" form
Yes
Unit A
Log Complaint
In addition to logging the complaint, the search unit copies the complaint for managers as well.

middle of it. Second, even if the number of programs sharing the CPU changes, DELAY still uses the same loop count. The resolution of the WAIT method isn't as fine, but WAIT will work in a multitasking environment.—*Neil J. Rubenking*

Dial the phone using your modem and this simple BASIC program

Nearly all modem modems recognize the Hayes command set. This makes it easy to dial a telephone number from within a BASIC program. The program fragment shown in Figure 5 prompts for a phone number and then dials it. The command

```
CLS
INPUT "Enter a number ", Phone$
OPEN "COM1:" AS #1
PRINT #1, "ATDT"; Phone$
INPUT "Press Enter to hang up ", X$
CLOSE
```

Figure 5: *This short program will dial a number you enter at the prompt.*

ATDT gets the modem's ATtention, then tells it to dial the number that follows using touch tones (Dial using Tone). To hang up, simply CLOSE the COM port.—*Larry Mingle; Chesterland, Ohio*

There are many other modem commands that can be sent from a BASIC program. For example, by changing the command string ATDT to ATDP, you can simulate rotary, or Pulse, dialing. Likewise, to set the modem to auto-answer mode, send the string ATS0=1. To disable auto-answer use ATS0=0. Note that you must use only uppercase letters when talking to a Hayes compatible modem.—*Ethan Winer*

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■ **ROBERT L. HUMMEL**

PC TUTOR

Why the Abort option won't always work when accessing a floppy disk; the reason you can't remove power from an internal hard disk; a utility that tests a floppy drive for various errors.

When choosing a compatible computer, selecting the BIOS maker can be a confusing choice

The PC AT clones that I see advertised usually specify the BIOS manufacturer. I have seen BIOSs manufactured by Phoenix, Award, Eden, and American Megatrends. What are the relative merits of each? Does it matter which one I get? *—Dale McIntyre; Centerville, Utah*

The BIOS (basic input/output system) program is a vital part of your PC. It contains most of the software needed to allow DOS to communicate with the hardware. Because the BIOS is contained in a ROM (read-only memory) chip, it's not easily patched or upgraded but must be replaced. If you get a BIOS that's full of mistakes, it can prevent you from running the programs you want to.

When you are writing a BIOS for any member of the IBM PC, it is no small undertaking, so it's unlikely that any of the manufacturers you mention would make a careless attempt at the project. Keep in mind, however, that the IBM is not perfect—or even the best on the market. Several serious programming errors have been found in each computer's BIOS that it has produced. But while we're generally stuck with a mistake that IBM programs into its BIOS, compatible makers, on the other hand, very often will fix and upgrade their BIOSs regularly. So more important than which BIOS you buy is getting the latest version. Some BIOSs also include enhancements. The American Megatrends (AMI) BIOS, for example, includes a setup and diagnostics program in its 80386 BIOS.

A small utility that lets a batch file test a floppy disk drive specification for various errors

I am having difficulty with a little routine I've been trying to implement. Basically, I've been trying to write a batch file that checks the floppy disk drive on my computer for the presence of a formatted disk, and if one is there, deletes any .BAK files.

```
N CRKDRV.COM
A 100
OR   AL,AL       ;AL=0 if 1st drive valid
JZ   010A        ; or FF if invalid
MOV  AL,02       ;Return errorlevel=2
MOV  AH,4C       ;Terminete
INT  21          ; thru DOS
MOV  DL,[005C]   ;Get drive number+1
DEC  DL          ; subtract 1
JNS  0116        ; not negative if okay
MOV  AL,03       ;Return errorlevel=3
JMP  0106        ; exit
MOV  AH,04       ;Verify diekette fn
MOV  AL,01       ; 1 sector
MOV  CH,00       ; treck 0
MOV  CL,01       ; sector 1
MOV  DR,00       ; side 0
INT  13          ; thru BIOS
JNC  012C        ;NoCarry=okay
MOV  AH,00       ;Reset diskette
IRT  13          ; thru BIOS
MOV  AL,01       ;Return errorlevel=1
JMP  0106        ; exit
MOV  AL,00       ;Return errorlevel=1
JMP  0106        ; exit

RCX
30
W
Q
```

Figure 1: *This DEBUG script can test a floppy disk drive to see if it's ready for a batch file to work on.*

The batch file looks like this:

```
CHKDRV
IF ERRORLEVEL 1 GOTO DOIT
GOTO END
:DOIT
DEL A:*.BAK
:END
```

where CHKDRV is the small .COM file I'm trying to write.

When the batch file runs with the disk drive empty, CHKDRV.COM generates a return code of 1, which causes the batch file to skip over the DEL command. If I put a blank, formatted disk in the drive and execute the batch file, CHKDRV continues to return a 1.

Why is this happening? Any assistance will be greatly appreciated.*—Richard D. Benton; Carson, California*

Don't blame yourself for overlooking this one—I don't think I've seen it in the manuals I have. The rule is that if you are going to mess around with the diskette system at the BIOS level (as your program does), you must clean up any mess that you make. In this case, accessing an empty drive leaves the diskette system in an error condition. Before using it again, you must reset the system with function 0 of interrupt 13h. Figure 1 shows a DEBUG script for my version of CHKDRV.COM.

First, create the file CHKDRV.SCR using a pure-ASCII text editor, like the *WordPerfect Library* Program Editor. Be sure to hit Return at the end of each line, including the blank lines. (Alternatively, you could type the commands directly into DEBUG.) You needn't type the semicolons or the comments that follow them.

Next, make sure DEBUG is in your current directory or in a directory listed in your path. Now create CHKDRV.COM with the following command:

```
DEBUG < CHKDRV.SCR
```

I've modified the program so it requires that the drive being checked be specified on the command line. So, for example, to check to see if a disk is in drive B: and ready, use the command

```
CHKDRV B:
```

The program returns the following ERRORLEVEL codes:

```
0 - Disk is okay
1 - Drive not ready
2 - Invalid drive
3 - No drive specified
```

The first two returns, 0 and 1, are the same as for your version. An ERRORLEVEL of 2 means that the drive specified does not exist. An ERRORLEVEL of 3 means that no drive was specified on the command line.

Note that the program will work only with floppy disks, not hard disks. Also note that the program is a little larger than it has to be. Some of the register moves, for example, could have been combined to save space. It is written, however, to show explicitly what each parameter does in the BIOS function calls.

Using the new version of CHKDRV, you could write the batch file shown in Figure 2 to automatically delete files with the extension .BAK from a floppy disk.

```
CHKDRV %1
IF ERRORLEVEL 3 GOTO ERR3
IF ERRORLEVEL 2 GOTO ERR2
IF ERRORLEVEL 1 GOTO ERR1
IF EXIST %1*.BAK DEL %1*.BAK
GOTO END
:ERR1
ECHO Disk Drive Not Ready
GOTO END
:ERR2
ECHO Invalid Disk Specified
GOTO END
:ERR3
ECHO Usage: CHKDRV d:
:END
```

Figure 2: *Here's an example of CHKDRV in action, helping a batch file perform file cleanup intelligently.*

Removing power from an internal hard disk

Your discussion of when to turn a PC off (PC Tutor, June 14, 1988) and when not to made good sense, but I have a follow-up question. I turn the power off only because of the hard disk. The rest of the computer would be better left on at all times. Why don't manufacturers include a switch that removes power from the hard disk?

Of course, such a switch should still be used sparingly, but at least we wouldn't "shock" the electronics by using it. If I were to install such a switch myself, could I just cut off the 12V line to the disk and let the 5V supply continue to power the on-disk chips, or would this hurt the drive? In particular, would this confuse park-and-lock?—*Pulak Dutta; Evanston, Illinois*

Manufacturers probably don't include a switch for two reasons. First, they don't have any idea into what type of machine their disk drive will be installed. Where would they mount the switch? And secondly, each switch would cost the disk maker a few cents of profit. In high-volume manufacturing, the name of the game is cost savings.

Now, back when the PC-XT was all the rage, many dual-floppy PC owners were upgrading their computers with external hard disks. These consisted of a special expansion card with an external connector, a separate chassis with the hard disk and its dedicated power supply, and a cable to connect the two. The power in the expansion chassis was controlled independently of the PC's power.

With this system, the PC could be turned on without powering up the hard disk. The self-test would indicate a disk error, then continue. If you needed the hard disk, you could turn it on, then reboot. The BIOS would detect the disk and initialize it. It could then be used normally. If you turned the disk off after the BIOS and DOS had recognized it, DOS would simply fail on the next attempt to use it. It worked then; it should work now. But I would stop short of modifying a drive that is installed inside the main computer chassis.

A disk drive mounted inside a chassis is subject to heat generated by other compo-

nents. These include floppy drives, memory boards, the CPU, and the math coprocessor. Leaving the power to the circuitry mounted on the disk drive while removing drive power would cause additional heat. By removing the power to the disk motor, you also remove the hard disk's ability to cool itself. This could lead to excessive heat buildup and damage.

In addition, certain tests and initializations must be performed by the BIOS and DOS when the drive is powered up. Engaging the disk during the middle of a DOS session could cause unpredictable and undesirable results. The automatic head retraction mechanism built into many hard disks is mechanically operated and requires no power.

The Abort option won't always work when accessing a floppy disk

What I thought would be an easily answered question seems to elude all those whom I've asked. Simply, with a two-floppy (plus hard disk) PC, if an empty floppy disk drive is addressed, the standard error message is produced asking for "Abort, Retry, Ignore?" Selecting Abort usually doesn't work until a disk is inserted into the vacant drive that has been addressed in error. I'm told that this is a DOS problem, but it's difficult to believe that it has not been addressed and fixed in all the years of DOS's life.—*Lester A. Gimpelson; Brussels, Belgium*

Although you didn't mention it specifically, I'll bet you're using an expanded prompt. Many PC users like to see what drive and directory they're logged onto and use the command PROMPT PG to display this information. This prompt, however, requires several accesses to the disk to determine the current drive and directory each time the prompt is displayed. Logging onto an empty floppy disk drive causes an immediate access to determine the current directory. Because the drive is empty, DOS invokes the critical error handler, displaying the Abort, Retry, Ignore? message. Typing an A to abort terminates the current error condition and returns control to DOS. DOS immediately attempts to display a new prompt and repeats the process that caused the error in the first place.

This will go on indefinitely until you place a disk into the empty drive. Instead of choosing Abort, use the Ignore (or Fail) option. This will return control to you after a few tries, allowing you to switch back to the hard disk. Alternatively, when you regain control, you could disable the nuisance prompt by executing the command again with no argument as follows:

```
PROMPT
```

The DOS ANSI.SYS driver doesn't work with larger screen sizes—but ANSI.COM does

I have several files that use ANSI codes to produce color, change screen modes, and so on. Can I leave ANSI.SYS loaded and still use the 43-line mode of the EGA?—*Donald N. Retzsch; Cincinnati, Ohio*

The ANSI.SYS device driver included on your IBM DOS distribution disks is a classic example of poor programming practice. Since no official IBM display mode exists that displays more than 25 lines, the ANSI.SYS program is "hardwired" to assume 25 lines. Thus, even if more are displayed, they are ignored.

To get over this problem, simply replace the ANSI.SYS driver with ANSI .COM (Utilities, *PC Magazine*, January 31, 1989). This completely compatible replacement provides full support for larger screen sizes, improved speed, and the ability to remove itself from memory.

Ask the PC Tutor

The PC Tutor solves practical problems, explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To have your questions answered here, write to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016 or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Productivity section). We're sorry, but we cannot answer questions personally.

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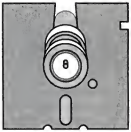

Tips on how batch files used on a network running Novell's NetWare can make it easier to use Lotus 1-2-3 and to track user performance more effectively.

Track log-ins and log-outs on a Novell network using a batch file

I have found another way to track log-ins *and* log-outs on a network running *NetWare* 2.0. I have over 30 users on our network, each with his own log-in script. These scripts all EXIT to one of six batch files. Rather than change all 30 log-in scripts in order to add the calling parameters in the EXIT command, I added these two lines to the system log-in script:

```
set UID=%login_name
set WS#=%p_station
```

Then I added

```
echo LOGIN  %WS#% %UID% >> f:\system
 \syslog\log.txt
echo systime >> f:\system\syslog\log.txt
```

to each of the six batch files.

I use a file called LOGOUT.BAT to record the termination of a session. However, before you create this batch file you must rename *NetWare*'s LOGOUT.COM to LOGOUT_N.COM. Then create LOGOUT.BAT as shown in Figure 1. Users of *NetWare* 2.1 may also be able to apply the same principle.

The otherwise slick *NetWare* MENU program has a bug in the way it handles environment space. When you run the MENU program it loads a new shell—similar to what happens in DOS when you load another copy of COMMAND.COM. In both cases, any environment variables that are already defined are copied to the new shell. However, unlike COMMAND.COM, MENU does not copy the size of the environment. Thus you may get a smaller environment than you expect.

I have a client who uses several COBOL programs that require setting a number of environment variables before starting a program. They use the SHELL= command in their CONFIG.SYS to enlarge the environment, then use a series of batch files to set the variables and run their programs. When these batch files were converted to be a part of the *NetWare* MENU system, they received "out of environment space" errors. The solution is clumsy but effective:

As a part of AUTOEXEC.BAT, or in the users' log-in script, include the lines

```
set dummy= '  '
set dummy2='  '
set dummy3='  '
```

Put as much space as you need between the commas to hold the environmental variables. Once in the MENU system, you can free up the space saved in the environment by typing

```
set dummy=
set dummy1=
set dummy2=
```

Thank you for a very useful column.
—Michael Merrick; Ann Arbor, Michigan

The popularity of homegrown Novell log-in and log-out batch files proves that many folks haven't felt the need to upgrade to *NetWare* 2.1. You will probably see a lot more log-ins than log-outs in the tracking files. This is because if a user station "hangs" or the user just shuts down without logging out, no LOGOUT record is written. Finally, when you save space with the `set dummy ' '` statements, remember that the maximum DOS environment string length is 127 characters.

Good batch files make it easier to use *Lotus 1-2-3* on a LAN

I read your column with great interest and have noticed several ideas that use Novell's *NetWare* to call device drivers.

We had a similar need to call device drivers on our Novell network, especially *Lotus 1-2-3* device drivers. *1-2-3* has a nasty habit of "hanging" a terminal when it is called with an incorrect device driver. Since we have four different Lotus configurations on our network (B/W, color, composite, and high resolution), employees were constantly "hanging" their terminals by calling the wrong configurations. It was especially annoying when someone "hung" the Novell ELS server

```
echo LOGOUT %WS#% %UID% >> f:\system\syslog\log.txt
echo systime >> f:\system\syslog\log.txt
LOGOUT_N
```

Figure 1: *LOGOUT.BAT writes a record of an ending session and then calls the renamed Novell LOGOUT.COM program.*

workstation, because the entire network had to be brought down in order to reboot the server. (The network can still operate with a "hung" server, but the resulting snail's pace is intolerable.)

To solve the problem, we used *NetWare*'s log-in script to create a DOS environment variable called PSTATION. This "Physical Station" variable is different for each terminal, but always remains the same for a particular terminal. Our log-in script is shown in Figure 2.

Next, we used the Lotus Installation Program to create the necessary configuration files (*.SET files) for each terminal. We went to each terminal, typed SET at the DOS prompt, and examined the list of environment variables. We recorded the PSTATION value of each station that was assigned by the log-in script. Finally, we created a batch file that uses these PSTATION values to run *1-2-3* with the correct driver from any terminal. The batch file is called L.BAT and is shown in Figure 3. This batch file has made life much more pleasant in the office.

As you can see, this file also calls the program "Squeeze" (SQZ), which compresses *1-2-3* files. Squeeze will not work in *1-2-3* high-resolution mode (90 × 38) because high-resolution mode uses graphics rather than text. Our smart little batch file knows not to run the Squeeze program with the high-resolution terminal.

```
:map s1:=sys:public\batch
:
:map s2:=sys:public
:
:map s3:=sys:public\dos
:
:map s4:=sys:
:
:COMSPEC=S3:COMMAND.COM
:
:SET PSTATION=P_STATION
:
:SET USER=LOGIN_NAME
:
```

Figure 2: *The log-in script used to create the DOS environment variable, PSTATION.*

```
ECHO OFF
CLS
CD \LOTUS
SPOOL TI1 NB FF > NUL
IF %PSTATION% == 000000000014 SQZ 123 BW
IF %PSTATION% == 000000000016 123 HIRES
IF %PSTATION% == 000000000002 SQZ 123 COMPOS
IF %PSTATION% == 000000000015 SQZ 123 COLOR
SPOOL NB TI=1 NFF > NUL
CD \
```

Figure 3: *This batch file calls the correct* Lotus 1-2-3 *video driver along with the Squeeze program, which compresses* 1-2-3.

This batch file also uses the SPOOL command to automatically send a form feed after each printout. This is necessary to ensure that one person's page will completely leave the printer before the next person's page begins. *1-2-3* does not automatically advance to the next page after a printout, so users often print on the bottom of each other's work. The SPOOL command corrects this problem. At the end of this batch file, another SPOOL command turns off the extra form feeds, so that blank pages are not constantly printed from other applications.

■ *NetWare*'s log-in script can create DOS environment variables allowing applications to perform differently for different users.

NetWare's log-in script can also create DOS environment variables allowing applications to perform differently for different users. Our log-in script sets the environment variable USER to equal the user's log-in name. Therefore, applications can run differently for different members of our office. For example, Julie needs to use the Formtool program with files in her own large subdirectory called \FORMTOOL\JULIE. When anyone else uses Formtool, he uses the general office subdirectory called \FORMTOOL\OFFICE. CHKUSER.BAT in Figure 4 checks the USER variable and sets the appropriate subdirectory. This batch file also uses PSTATION to determine whether the workstation is B/W, color, or composite.

```
ECHO OFFCLS
W:
IF %USER% == JULIE CD \FORMTOOL\JULIE
IF NOT %USER% == JULIE CD \FORMTOOL\OFFICE
F:
CD \FORMTOOL
IF %PSTATION% == 000000000014 FORMTOOL /N /M=M W:
IF %FSTATION% == 000000000016 FORMTOOL /N /M=M W:
IF %PSTATION% == 002000000002 FORMTOOL /N /M=B W:
IF %PSTATION% == 000000000015 FORMTOOL /N /M=C W:
W:
CD \
F:
REM TEMPORARILY POINT W: THEN RESET TO ROOT DIR.
```

Figure 4: *CHKUSER.BAT checks the identity of a user, sets the appropriate drivers, and changes to the appropriate subdirectory.*

Of course, more than one person can be logged in as Julie at one time, if desired.—*Mark Paley; Albany, New York*

These are well-explained, integrated examples of the use of PSTATION to set drivers. Keeping users in the right subdirectory for a specific application is a headache that can be soothed with the techniques shown in CHKUSER.BAT. You can do all this so the end users don't even know they're on a network.

Productivity Tip

The ability of *NetWare, VINES, PC LAN*, and the various flavors of *LAN Manager* to internally bridge two to four adapter cards is valuable but often overlooked. You can gain distance, improve performance, and save money by internally bridging similar or different network adapter cards in your server.

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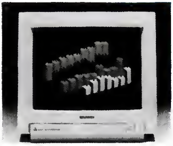

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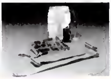

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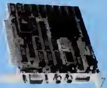

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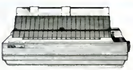

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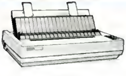
- In draft mode or Letter Quality mode, the LQ-850 runs at a surprisingly quiet 55 dB noise level



Epson LQ-1050

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- Epson's SmartPark™
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
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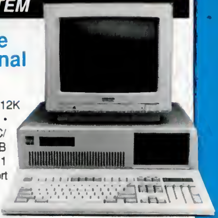

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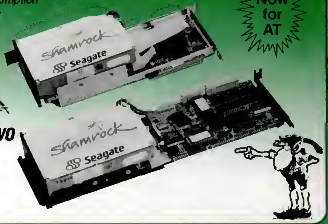
Leprecards feature Seagate drives, the acknowledged leader in technology and reliability. You can use them as the first or second hard disk in your system. Low power consumption drives mean less strain on your system. You get a 1 year warranty, unlimited technical support & our illustrated installation and user's guide. Models available for IBM PC/XT and compatibles, AT's and compatibles, as well as the TANDY 1000/A/SX/TX/TL/SL.

***FREE SOFTWARE: TakeTwo,** the backup utility PC MAGAZINE named Editors Choice in 1986 & 1987, & **PC KWIK** disk cacheing from Multisoft.*

Now for AT

Tandy 1000 Model



MODEL	LPC 30/40	LPC 49/28
DRIVE	ST138R	ST157R
SIZE/PERFORMANCE	32MB 40ms	49MB 28ms*
8 BIT PC/XT TYPE	**$389**	**$549**
16 BIT PC/AT TYPE	**$449**	**$599**

**Average access speed per partition. Tandy 1000/A/SX/TX Leprecards add $20.*

Seagate PC/XT Disk Kits

- *Pretested & formatted*
- *Western Digital short slot controller*
- *30 Page installation guide & reference manual*
- *Cables, mounting screws, full & half-height face plates*
- ***TakeTwo** backup software, PC MAGAZINE "Editors Choice"*
- ***PC-KWIK** cache software by Multisoft*
- *1 Year Warranty, 30 Day Money Back Guarantee*
- *Optional: 150 watt, UL/FCC approved power supply for IBM PC's, $69*

TANDY 1000 kits add $20

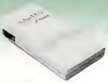
20MB KIT $279
- *Seagate ST225 - 21.4MB/65ms./Half-Height/14.8 watts*

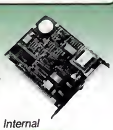
30MB KIT $299
- *Seagate ST238 - 32.7MB/65ms./Half-Height/14.8 watts*

40MB KIT $459
- *Seagate ST251 - 42.8MB/Half-Height/11 watts*
- *Preformatted into a pair of 21MB/28ms. partitions*

65MB KIT $499
- *Seagate ST277R - 65.5MB/Half-Height/11 watts*
- *Preformatted into a pair of 32MB/28ms. partitions*

LepreFAX Modems





External **$359**

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4800 **$289**
9600 **$559**

- *Sends/Receives from any Group 3 Fax*
- *Sends ASCII or word processing files*
- *Prints on standard dot-matrix or laser printers*
- *Easy to use Pop-up Menus*
- *Automated sending during low phone rate periods*
- *Portable external plugs into PC/XT/AT serial port, $359*
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- *InfoWorld Product of the Year*

AT Disks

- ***Seagate** Drive with IBM AT rails & cables*
- ***SpeedStor or OnTrack** large drive software*
- *Formatted, Partitioned & Tested*

Size	Model	Speed	Format	Capacity	Price
HH	ST251	40ms	MFM	48MB	$359
HH	ST251-1	30ms	MFM	42MB	$449
HH	ST277R	40ms	RLL	65MB	$439
FH	ST4096	28ms	MFM	80MB	$599

286^{12} Computer

PERFORMANCE RATINGS

SYSTEM	NORTON SI Ver4.0	MIPS	PowerMeter
IBM Model 50Z	11.2	1.6	147.2
Compaq 386-16	15.6	2.8	319.9
Shamrock 286-12/0	15.3	2.5	253.3
Shamrock 286-12/1	11.8	1.9	178.9

-80286-12Mhz 1 wait state (0 optional)
-8 slot American made motherboard
-Room for 1 full and 3 half-height drives
-220 watt power supply, Award BIOS
-Serial/Printer ports, Clock/Calendar
-Choice of 1.2 or 1.44MB floppy drive
Western Digital 1:1 interleave Disk controller
*-**LepreKeys** Enhanced keyboard with tactile switches & built-in calculator*
-RAM standard expandable to 1MB,
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Monographics Card & Monitor	**$1049**
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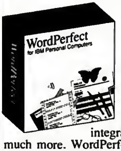
SPECIALS

WordPerfect 5.0

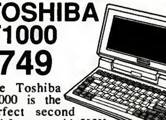


$215

List $495

The most popular word processor is now even better than ever! Version 5.0 adds multiple font support, graphics integration, page preview and much more. WordPerfect 5.0, still retains its feel and ease of use that made it #1. Combine this with the best support in the industry and you can't lose.

TOSHIBA T1000



$749

The Toshiba T1000 is the perfect second PC! It comes with 512K of ram, a 720K floppy drive, a supertwist LCD screen and MS-DOS in rom! All this in a battery-powered 7 pound package. A 768K ram card is just $269 and can be set as base, expanded, or a non-volitile ram disk.

Panasonic KX-P1124

24 Pin Printer

$309

Panasonic's new 24 pin dot matrix printer gives you more features per dollar! It comes with paper parking and three paper paths for easy handling. The EZ-set operator panel lets you choose from five fonts, six pitches, perf cut and more. Its 11.7" carraige is perfect for envelopes or single sheets in landscape mode. All this and a two year warranty.

HARDWARE

PRINTERS

	LIST	*FAST*
ALPS		
Allegro 24	499	319
Citizen		
120D	229	145
180D	259	165
MSP40	449	299
Tribute 124	599	429
Diconix		
150P	499	299
Epson		Call
Fujitsu		
DL3400	995	549
NEC		
P2200	569	339
P5200	799	509
P5300	1049	669
LC890	4799	Call
Okidata		
182 Plus	319	219
320	499	329
390	699	469
393	1499	949
Panasonic		
KXP1080i-2	299	159
KXP1091i-2	329	179
KXP1124	529	309
KXP1595	749	419
KXP1524	949	519
KXP4450	2595	1499
Star		
NX1000	289	159
NX2400	499	315
NB2410	699	429
Toshiba		
P321SL	749	459
P341SL	999	599
P351SX	1499	929

BOARDS

	LIST	*FAST*
AST		
Hot Shot 286	645	339
Six Pak Plus 64K	210	119
DTK		
286 10mhz M/B	499	249
XT 1.2mb FDC	79	45
Everex		
1200B Int Modem	149	69
2400B Int Modem	249	129
Genoa		
Super EGA Hi-Res+	399	169
Super VGA #5100	445	239
VGA Hi-Res #5200	645	359
Hercules		
Graphic Card +	299	169
Intel		
8087-2	250	149
80287-10	480	249
Above Board Plus	795	419
Orchid		
ProDesigner	499	299
Tiny Turbo 286	445	269
Twin Turbo 12mhz	645	359
Paradise		
Autoswitch 480	349	169
VGA Plus	399	259
VGA Plus 16	499	299
VGA Professional	799	Call
Practical Peripherels		
1200B Int Modem	99	65
2400B Int Modem	199	149
Prometheus		
Promodem 2400B	199	129
Promodem 2400G	249	159

The Complete PC	LIST	*FAST*
Answering Machine	349	219
Fax	399	249
Hand Scanner	249	159
USRobotics		
1200 Baud Internal	149	69
1200 Baud External	179	89
2400 Baud Internal	249	119
2400 Baud External	279	149
Video 7		
Fast Write VGA	549	335
Vega Deluxe	379	Call
Vega VGA	499	259
V-RAM VGA	899	469

LAPTOPS

	LIST	*FAST*
Megehertz Modems		
2400B Toshiba	299	149
2400B NEC, Epson Mitsubishi or Zenith	399	199
Mitsubishi		
MP-286L Dual	3195	1879
MP-286L 20mb	4595	2449
NEC		
Multispeed EL II	2295	1449
Multispeed HD	3695	2249
Toshibe		
T1000	1249	749
T1200F	2099	1369
T1200FB Backlit	2399	1499
T1200HB Backlit	3599	2399
T1600	4999	3359
T3200	5799	3495
T5100	7499	4495
Zenith		Call

MONITORS

	LIST	*FAST*
Magnavox		
7BM749 VGA	229	149
9CM082 VGA	649	419
Mitsubishi		
1409 RGB	399	259
1410 EGA	599	399
Diamond Scan 1381	799	479
NEC		
Multisync II	899	575
Multisync Plus	1399	869
Princeton		
Max15	389	Call
Utltrasync	849	489
Utlira 16	1375	859
Seiko CM1430	995	599
Sony		
1302 Multiscan	995	659
1303 Multiscan	825	469
Zenith 1490	999	599

DISK DRIVES

	LIST	*FAST*
Miniscribe		
40MB AT #3650	499	319
Mitsubishi		
40MB AT MR535 22ms	825	399
Seagate		
20MB XT Kit #225	599	267
30MB XT Kit #238	699	287
40MB AT #251	899	349
40MB AT #251-1	999	449
80MB AT #4096	1199	549
Toshiba		
360K Floppy	119	69
720K 3.5" Floppy	149	79
1.2MB 5.25" Floppy	149	79
1.44MB 3.5" Floppy	189	99

Call On Non-Listed Items

SOFTWARE

Database

	LIST	*FAST*
Clipper	699	Call
DataEase	600	379
dBase IV	795	449
dBXL Diamond	199	105
Foxbase Plus	395	185
Paradox	725	429
Quartz	795	449
RapidFile	295	179
Rbase for DOS	700	419
Reflex	150	90
Q & A	349	179
Desktop Publishing		
Byline	295	175
GEM Desktop Pub.	299	169
Pagemaker 3.0	795	Call
PFS:First Publisher	129	69
Publisher's Paintbrush	285	149
Ventura 2.0	895	489
Financial		
Bedford Integr. Acct.	249	139
BPI		Call
Computer Associates		Call
DAC 3.0	99	59
DAC Payroll 3.0	99	59
Dollars & Sense	179	99
Managing Your Money	199	117
Peachtree Complete II	199	149
Turbo Tax 1040	75	42

Graphics

	LIST	*FAST*
Deluxe Paint II	105	67
First Graphics	129	Call
Freelance Plus	495	Call
GEM Artline	495	269
GEM Draw Plus	299	165
Generic Cadd Level 3	200	97
Graph Plus	495	299
Harvard Graphics	495	Call
Perspective Jr.		Call
Integrated		
First Choice	159	Call
Works	149	89
Windows 286	99	59
Windows 386	195	117
Mice		
Logitech C7 Serial/Bus	119	65
Logitech HiRes Bus	150	79
Microsoft Serial/Bus	150	95
Microsoft W/ Windows	200	129
OmniMouse	89	45
PC Mouse II Serial/Bus	149	82
Power Protection		
Curtis Ruby Plus	115	59
Datasheild 85	90	50
Datasheild 100	99	57

Programming

	LIST	*FAST*
Macro Assembler	150	89
Norton Guides (Specify)	100	58
Turbo Basic	99	60
Turbo C 2.0	149	90
Turbo Pascal 5.0	149	90
Quick Basic	99	60
Quick C	99	60
Spreadsheets		
Allways	150	82
Excel	495	Call
Lotus	495	Call
Lucid 3-D	149	79
Quattro	248	149
Utilities		
CoreFast	149	87
Desklink	170	95
Desqview	130	73
Fastback Plus	189	99
FastTrax	60	37
Formtool	95	54
Laplink Plus	140	77
Norton Advanced	149	74
PC Tools Deluxe	80	36
Sidekick Plus	195	119
XTree	70	34

Word Processors

	LIST	*FAST*
Ami	149	89
Easy Extra	99	55
GEM First Word Plus	199	117
Grammatik III	89	49
Manuscript	495	Call
Multimate Adv. II	565	247
Professional Write	199	109
Rightwriter	95	49
Sprint	195	119
Q & A Write	199	109
Webster's Writer	60	47
Word	450	Call
Word Perfect	495	Call
Word Perfect Library	129	60
WordStar Prof. 5.0	495	219

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1124 **Call**

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Canon BJ-130	689
Citizen	Call
Diconix 150	295
HP LaserJet II	1759
JDL 850 Series	Call
NEC LC890	Call
Panasonic 1080i-m2	155
1091i-m2	189
1124	314
1592/1595	382/418
1524	515
Toshiba 321-SL	499
341-SL	660
351-SX	996
Others	Call

MONITORS

Amdek 1280 & Card	639
210A	87
Hitachi 20" SuperScan	2090
Mitsubishi Diamond Scan 1381	477
Moniterm Viking	Call
NEC Multisync II	585
Multisync GS	185
Others	Call
Samsung	Call
Sigma Designs LaserView	
15" SE Apple	1198
19" AT/PC	1499
15" Mac II	1179
19" Mac II	1560
Sony Multiscan 1302	650
Multiscan 1303	475
Zenith 1490 Flatscreen	579

SOFTWARE

AutoSketch®	59
BoeingGraph	189
By-Line	169
Carbon Copy Plus	103
Clipper	398
Copy II PC	18
Corefast	75
Dac Easy 3.0	58
dBase IV	Call
DesignCad	145
Desklink	92
DesqView	69
Drafix 1 Plus	Call
Drafix Ultra	Call
Drafix 3D Mod & Options	Call
Dollars & Sense	95
Easy Xtra	54
Excell PC	281
FastBack	69
FastBack Plus	87
FormTool	52

SOFTWARE (cont.)

Freelance Plus	293
Fox Base Plus	179
GEM Draw Plus	159
Generic Cadd 3.0	48
Generic Cadd Others	Call
Harvard Graphics	255
In House Acct	107
King Quest IV	35
Laplink Plus	74
Liesure Suit Larry II	35
Lighting Hard Disk Speedup	59
Lotus 123 2.01	Call
Lotus Agenda	Call
Managing Your Money	113
MathCad 2.0	195
MicroSoft Flight Sim	35
MicroSoft Windows 2.0	56
MS-Dos 3.3	95
Norton Util 4.0	45
Novell Netware 286	Call
PageMaker 3.0	Call
Paradox 2.0	Call
PC Tools Deluxe	Call
PathMinder 4.0	55
Peachtree Accounting II	145
Peachtree Quere	Call
PFS: First Choice 3.0	85
PFS: First Publisher 2.0	67
PFS: Professional File 2.0	Call
PFS: Professional Plan 1.02	51
PFS: Professional Write 2.0	102
Plan Perfect	185
Q&A	177
Q&A Write	115
Quattro	149
Rapid File	172
R:Base for DOS	415
ShipMate™ (ups Manifest)	199
SideKick Plus	Call
Smart Sysmen	418
Sprint	115
Tops	101
Turbo Basic	62
Turbo C	92
Turbo Pascal	57
Ventura Publishing 2.0	458
VersaCad & Libraries	Call
Windows	Call
WordPerfect 5.0	213
XTree	33
XTreePro	58
XTreeNet	Call

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1043-GT	5898
Drawing Brd 12x12 16-Btn	369
Enter Sweet-p 600	598
Houston Instruments	
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DMP 51MP	3550
DMP 51	3200

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DMP 52	2300
DMP 56A	3800
DMP 61	2890
DMP 62	3990
MP Options	Call
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PumaPro 12x12,4btn,Pen,SW	349
PumaPro 12x12,12btn,SW	369
ioline	Call
JDL 850 Series	Call
Kurta IS 12x12	285
IS 12x17	485
Summagraphics 12x12 Plus	329
18x12 Pro w/4 Butt & Stylus	559
Mac Bit Pad 12x12, 4But,Sty	269

T-1000
$779

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Others	Call
ScanMan	155

Clones 286/386 .....Call

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Seagate ST225 w/card	260
ST238 30Mb w/card	285
Sharp Fax UX-140 & Phone	969
Smart Modem 1200B int w/sw	58
2400B int w/sw	115
Teac 3.5" 720k Drive	79
3.5" 1.44Mb Drive	95
5.25" 360k Drive	75
5.25" 1.2Mb Drive	87
US Robotics	Call

BOARDS & NETWORKS

3-Com Etherlink	Call
Adage AD10/4	Call
AD10/8L	Call
ArcNet	Call
Artist	Call
AST	Call
ATI EGA Wonder	169
VIP VGA	249
Copy II Opt Board Dlx	95
EtherNet Plus	Call
Genoa VGA 760x1024	379
Hercules Graphics Plus	169
Intel AboveBoard 286/512k	359
AboveBoard PS 286/512k	388
Paradise EGA 480	Call
VGA Plus	Call
VGA Plus 16	Call
VGA Pro	Call
Sigma Designs VGA	209
Tops Flashcard	143
Verticom	Call
Video 7 Vega Deluxe	177
V-Ram	Call
Vega VGA	$255
Western Digital EtherNet Plus	Call

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286 Model 140X	2098
386 Model 300	2475
Mitsubishi MP286L	Call
NEC Multispeed	1079
Multispeed EL II	1423
Multispeed HD	2209
Toshiba Laptops	Call
T1000	779
Zenith Laptops	
SuperSport-Dual	1570
SuperSport 20Mb	2357
SuperSport 286 20Mb	3298
SuperSport 286 40Mb	Call

Intel coprocessors

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8087-2	132
80287-8	205
80287-10	239
80387-16	Call
80387-20	Call
80387-25	549
80387-SX	398
80C287A (for Laptops)	299

MOUSE

Logitech C7 Serial or Bus	64
C7 Clear Mouse & Paint	85
HiRez Bus	82
Bus & Paint	82
Serial & Publisher	104

OPTICAL

OptiDriver Kit	525

40 ms equiv. for most optiDrives

DataBase Special

dBase IV ... 455
FoxBase Plus ... 179
Paradox ... 429
Rapid File ... 175
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MSER	3-Button, Serial Mouse	$99.95
MBUS	3-Button, Bus Mouse w/board	$99.95

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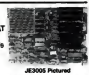

JE3005 Pictured

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JE1002	4.77/10MHz (PC/XT)	$109.95
JE3005	8/12MHz (AT)	$329.95
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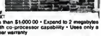

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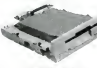

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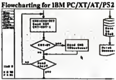

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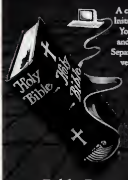

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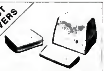

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s. ☐ Mini(s)

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u. ☐ In 4 to 6 months
v. ☐ In 6 to 12 months
w. ☐ No definite plans

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COMING UP

NUMERICAL ANALYSIS SPECIAL ISSUE The increasing speed and computational power of PCs and user demands for desktop number-crunching capability have lured PC software developers into a market formerly served only by minis and mainframes. To sort out the software side of PC number crunching, *PC Magazine* examines over 80 packages in our first special issue devoted solely to numerical analysis.

STATISTICAL ANALYSIS Business and science today share the same craving for information and results. *PC Magazine* covers the statistical software market with reviews of 49 packages. Industry experts evaluate advanced statistical software including PC versions of the major mainframe players such as *BMDP*, *SAS*, and *SPSS;* as well as forecasting packages, econometric modeling software, and the simpler, more affordable statistical software.

MATH TOOLBOXES Making pencil and scratchpad obsolete, equation-solving software has raised number crunching to new heights. These packages are proving themselves to be invaluable to scientists, engineers, programmers, and financial model builders. Sixteen programs see if it all adds up, quickly and easily.

SCIENTIFIC GRAPHING Spoiled by the 20-MHz 386 computers on their desks, scientists still must get by on underpowered business graphics software. Or do they? *PC Magazine* reviews 14 packages that are capable of handling logarithmic scales, data sets with thousands of plots, rotation of the y-axis label for scientific illustrations, as well as two- and three-dimensional graph and surface representations.

FREE UTILITY How do you diagnose what's wrong when your printer won't print or your modem won't send? Plug in LITES—a utility that simulates a breakout box and diagnoses sticky asynchronous I/O problems. It'll save you time and money. And it's only an issue away.

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AFTER HOURS

J. K. Lasser

(continued)

en data to appear. Press Alt-Q to tell the program where to find your *Quicken* file. Presto! A big window opens up with the *Quicken* file contents either completely visible or scrollable. Move the selector line to the number you want and press Enter. The window disappears, and the number you selected is on the line of the tax form where you started.

If you need to subtract or multiply a few numbers as you go along, a pop-up calculator appears at the press of the F9 key. If an IRS worksheet or further supporting form is available, pressing F7 will bring it up. If you want to see how your tax liability changes as you go, just hit F5 while on a supporting form to bring up a window showing your total tax, as well as the amount you owe or the amount of the refund due you. And *Lasser*'s file-handling system is flexible enough to let you use the program for any number of individual tax returns.

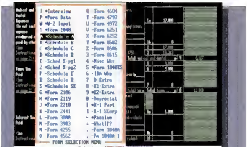
For the folks in California and New York, *Lasser* has state income tax-return programs for $39.95 that pick up the figures directly from the *Lasser* federal forms you've filled in.

If you'd like to compare the cost of filing a joint return with the tax owed by two people using the married, filing separately status, use the Analysis feature from the pull-down menu. It lets you load a file you've already filled out and compare it with another existing file or the figures that you enter in a second column right then and there. The program also includes tax planning for 1989.

At printout time, the *Lasser* program does an IRS-approved Form 1040 if you have an Epson, an IBM Graphics, or a compatible dot matrix printer. This approved 1040 format will not print on a laser printer. As with the supporting forms, output will be in the laser or other printer's default typeface.

List Price: *J. K. Lasser's Your Income Tax*, $69.95; state modules for California or New York, $39.95 each. **Requires:** 256K RAM, DOS 2.1 or later. Not copy protected. Simon & Schuster Software; One Gulf+Western Plaza, New York, NY 10023; (212) 373-8500.

CIRCLE **684** ON READER SERVICE CARD



The virtuoso graphics of TurboTax*'s Schedule A are visible in the background when you press F6 to make your next form selection*

TurboTax

Leading the pack is ChipSoft's latest version of *TurboTax*, with its fast, classy operation and a full complement of new and improved features. Relatively easy to use and probably the most comprehensive in calculations, the $75 *TurboTax* is a very impressive program.

After you load *TurboTax* onto your hard disk (not required but nice), you are presented with a personal data sheet where you enter your name, address, and social security number. Once you've completed that, everything you need to know is available through a series of pop-up menus invoked with the Slash key or through the F1 help key.

TurboTax also contains a personal interview feature that asks over 50 short questions about your financial situation for the past year. Run through these questions and, on the basis of your answers, a pull-down window appears listing all the forms and schedules that might be required to cover the transactions involved.

Next, you'll want to consult the Forms menu to bring up a worksheet or form or schedule that looks very much like the IRS's own versions. For your aesthetic diversion, *TurboTax* will now run in a graphics mode that shows the official form in black on white (or white on black) on the screen. While it's attractive, I found I'd still rather use the old-style screen with its color coding of protected cells. The scheme reminds me to go back and fill out a supporting schedule where a little more math needs to be done before carrying the number to the protected cell. If I want to circumvent laborious backup for protected cells, there is an override on the menu.

You may wish there were a genie at your elbow to offer a few words of explanation as you hover over such gems as "Enter your IRA designated nondeductible contributions for 1988." The next best thing: summon up instructions from the pop-up menu, and the program's window zeros in on the official government attempt to explain that particular line.

For those who've spent the year using Intuit's *Quicken*, Star/Monogram's *Dollars & Sense*, MECA's *Andrew Tobias' Managing Your Money*, or a spreadsheet that will produce an ASCII file, you can now import your figures into the *TurboTax* forms using the new Interface feature. Just enter the drive, path, and filename where you stored the financial data, and the file appears on-screen. Move the cursor over a key figure of the imported file, press Return, and the file disappears—leaving the key number in the block you selected on the tax form. If you want more figures from the same file, choose Interface from the menu again, and the previously selected file reappears as the default.

Last year *TurboTax* introduced a driver for a dot matrix Form 1040 that the IRS would accept for filing along with the supporting forms in ordinary type. This year the same filable 1040 rolled out of my Hewlett-Packard LaserJet Series II without the use of any special font or cartridge.

TurboTax is unique among personal tax software in offering modules for 41 states (at $40 each) that pick up your federal tax data directly from the federal programs. Most of these state programs require very little additional input to create the finished state returns.

An excellent manual contains 250 pages of well-organized instructions on the mechanics of making the program run and print, as well as two or more pages explaining each form, schedule, or worksheet.

Once you're finished with your 1988 return, you can always try running the Tax Planner module to see where you'll stand by the end of this year.

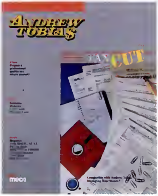
List Price: *TurboTax*, $75; each state module, $40. **Requires:** 256K RAM for DOS 2.0 or later, 384K RAM for DOS 3.0 or later. Not copy protected. ChipSoft Inc., 5045 Shoreham Pl., #100, San Diego, CA 92122; (800) 782-1120 or (619) 581-2233.

CIRCLE **683** ON READER SERVICE CARD

Laura Lou Meadows is a practicing tax lawyer in New York.

WHAT YOUR ACCOUNTANT MIGHT NOT WANT YOU TO KNOW*

*Andrew Tobias' Tax Cut lets you prepare a professional quality tax return yourself – even if you're a novice at tax preparation.



All the features you need

Tax Cut automatically calculates and prints your completed 1040 return and up to 23 other IRS-approved forms and schedules. It finds the tax approach that saves you the most money: whether you should file jointly, itemize, take the zero bracket amount, and much more. It features an instant tax summary window that lets you see where you stand at any point in the program, and "What if" calculations on any form or schedule for important planning before year-end.

Works like an easy interview

Unlike other programs, Tax Cut "interviews" you in friendly layman's terms and without IRS jargon — the same way an empathetic accountant might. It uses your answers to automatically select the schedules you need, and then computes and prints your tax return based on current tax law. All you do is answer, sign and file!

You answer each question only once. Tax Cut automatically transfers the information to every line or schedule where it's needed, and performs computational checks to make sure your answers are consistent.

With Tax Cut, you need not see any IRS forms until the program prints your return. (If you do wish to review the forms on-screen, just use the easy display feature.)

Saves you valuable time

With Tax Cut, even the most complex tax returns rarely take more than one hour. Compare that to time-consuming trips to an accountant. Or treks through the January slush to get the proper forms from the IRS office. Or the time-burning tedium of mistake prone manual preparation, which has you transferring the same information from line to line and form to form.

CIRCLE 391 ON READER SERVICE CARD

meca®

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355 RIVERSIDE AVENUE, WESTPORT, CT 06880

Saves you money, too

Tax Cut helps you know what financial decisions to make, and when to make them, for maximum tax savings. It eliminates the mathematical errors that can result in overpayment. It checks to see that you don't pay more FICA than you should (a common mistake). And most important, with Tax Cut there's no more need to spend significant amounts of money for professional quality tax preparation you can easily do yourself.

Comprehensive yet simple

Tax Cut is written by a team of tax professionals and personal finance expert Andrew Tobias. Together, they bring you a program that is fully comprehensive and current, yet simple enough for even a tax novice.

Guaranteed Accuracy: A Tax Cut Exclusive

Unlike any other program, if the IRS makes you pay a penalty because of a mathematical miscalculation in Tax Cut, we'll pay the penalty.

Guaranteed Satisfaction
If for any reason you're not completely satisfied with Tax Cut, return it to us within fifteen days for a full refund.

Only $79.95 suggested retail.
See your dealer or call toll free to order:

1-800-835-2246 ext. 12

...or mail the coupon today.

- Includes forms 1040, 1040 ES, 2106, 2119, 2210, 2441, 3468, 3800, 3903, 4562, 4797, 4952, 5695, 6251, 8582, 8598, 8615 schedules A, B, C, D, E, F, SE.
- Accepts leading printers.
- Compatible with Andrew Tobias' Managing Your Money.

Requires:
320K IBM® PC's or compatibles
80 column monitor • 2 disk drives • DOS 2.0 or later
Not copy protected.

Form **1040** Department of the Treasury – Internal Revenue Service **U.S. Individual Income Tax Return 1988** (2) **PCM**

Label

please print or type

☐ **YES, I'd like to do a professional quality tax return easily and inexpensively.** Send me Tax Cut for $79.95 + $2.50 shipping and handling (CT residents add 7½% sales tax).

Name

Address

City State Zip Phone

Filing Status

Credit card # (V, MC, AMX) ▶ ______ / ______ / ______ exp. ______ ☐ 5¼" ☐ 3½"

Signature required

☐ Enclosed is my check payable to MECA Ventures, Inc.

Exemptions

If I am not completely satisfied with Tax Cut, I will return it to you within 15 days for a full refund.

Mail coupon to:
MECA Ventures, Inc. • 355 Riverside Avenue • Westport, CT 06880

Ask Dan

(continued)

calculator for doing backup calculations when you want to transfer the total to the form. Press F1 twice to bring up a window of general background information and instructions pertinent to the form you are working on.

If your financial records are stored in a spreadsheet, database, word processor, or financial management program, you can import the first two columns—say, one of descriptions and one of numbers—into the scratch pad. You'll need to put the source file into ASCII format to do this.

The prize feature of this program is the *Ask Dan* dialog, which uses your responses to a series of questions to help you fill out your return.

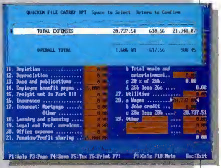
For instance, during the exchange on selling a principal residence, the program asks if you've used part of the home for business, and if so, explains how to split the data pertaining to the sale. It sets forth special tax benefits that may apply to the sale and takes you through the requirements for each one. It asks about the form of the proceeds, covering an outstanding mortgage that your buyer might assume and a purchase money mortgage that you might take back from a buyer. When you feed in your expenses of the sale, the program notes that if your move was caused by changing jobs, you might be able to save money by reporting these items on Form 3903, which deals with employee moving expenses.

Ask Dan is prudent enough to acknowledge that no computer program takes the place of a live tax specialist when it comes to the more arcane reaches of revenue law esoterica, but it uses artificial intelligence to help you gain wisdom in over two dozen problem areas, such as refunds of state and local taxes and IRAs.

When you're finished with the forms, check the results with the program's Auditor feature. It will remind you of overrides or missing entries and then give you suggestions related to your situation for tax savings next year. Since the tax advice is right on the screen, the 70-page, easy-to-follow manual concentrates mainly on the mechanics of the program. Printing is limited to acceptable supporting schedules, plus a facility for printing the 1040 on pin-feed forms or typing out the 1040 figures to be copied manually to the official IRS form.

Programs for California, Massachusetts, and New York state taxes are planned but were not ready in time for this review.

List Price: *Ask Dan About Your Taxes*, $89.95. **Requires:** 512K RAM, DOS 2.0 or later. Not copy protected. Legal Knowledge Systems Inc., P.O. Box 695, Drexel Hill, PA 19026; (215) 789-3679.



```
QUICKEN FILE CATREP RPT  Space to Select  Return to Confirm

TOTAL EXPENSES                 20,737.51    610.56   21,340.07

OVERALL TOTAL                   1,606.01   -617.56      988.45

11. Depletion ..............                 b Total meals and
12. Depreciation ...........                   entertainment..
13. Dues and publications ...                c 20 % of 26b..      0.00
14. Employee benefit prgms ..                d 26b less 26c ....  0.00
15. Freight not in Part III .            27. Utilities .........
16. Insurance ...............            28. a Wages ........ 20,737.51
17. Interest: Mortgage ......                b Jobs credit ...
              Other ........                 c 28a less 28b .... 20,737.51
18. Laundry and cleaning ....            29. Other
19. Legal and Prof. services.
20. Office expense ..........
21. Pension/Profit sharing ..                                      0.00

F1:Help F3:Page F4:Save F5:Tax F6:Print F7:     F9:Calc F10:Note    Esc:Exit
```

J K Lasser's Your Income Tax *lets you scroll down to the bottom line of your* Quicken *file to select and enter the number to transfer to your tax form*

Tax-Preparation Programs: Finding the Forms and Schedules You'll Need

	Forms	Schedules
Andrew Tobias' TaxCut	1040, 2106, 2119, 2210, 2441, 3468, 3800, 3903, 4562, 4797, 4868, 4952, 6251, 8582, 8598, 8615	A, B, C, D, E, F, SE
Ask Dan About Your Taxes	1040, 1040ES, 2106, 2119, 2210, 2441, 3903, 4562, 4684, 4797, 4972, 6251, 6252, 8582, 8598, 8606, 8615	A, B, C, D, E, F, R, SE
J.K. Lasser's Your Income Tax	1040, 1040ES, 2106, 2119, 2210, 2441, 3468, 3800, 3903, 4137,4255, 4562, 4684, 4797, 4868, 4952, 4972, 5329, 6251, 6252, 8582, 8598, 8606	A, B, C, D, E, F, R, SE
TurboTax	1040, 1040A, 1040ES, 2106, 2119, 2210, 2441, 3800, 3903, 4255, 4562, 4684, 4797, 4952, 4972, 6251, 6252, 8582, 8606, 8615	A, B, C, D, E, F, R, SE

J. K. Lasser's Your Income Tax

Off to a fast start last year, *J. K. Lasser's Your Income Tax* gets a big boost from being packaged with the time-tested paperback, *J. K. Lasser's Your Income Tax*, an over-300-page guide that has been the do-it-yourselfer's tax bible for more than 50 years.

The $69.95 program opens with a screen for filling in data such as name, social security, and marital status. Next, it asks if you know what forms to file or if you'd like to take a short interview to find out. On the basis of the interview, a list of the forms and schedules you will need comes up. If further study reveals that you need more forms, it's easy to choose them later.

The program then takes you to the pull-down menus, where you select the forms to fill out. If you like starting with the Form 1040, the program accepts information until you get to a cell where the number should be derived from a supporting form or schedule. Plug numbers and overrides are not fair play here. The program directs you to fill out the appropriate supporting form before going any further on the 1040.

The *Lasser* tax software benefits from its ability to key its on-line instructions to the *J. K. Lasser's Your Income Tax* guide. When you press F1 to bring up the instructions for a particular line, the window gives a summary sentence or two, then directs you to the paragraph number in the companion book where that topic is treated at much greater length.

Lasser can import figures from Intuit's financial record-keeping program, *Quicken*. The fastest way to do this is to put the cursor on a line of the tax form where you want the *Quick-*

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continues

Andrew Tobias

(continued)

that the program makes.

Using *TaxCut*, you can prepare a complete and complex return as long as it's within the program's 23 forms and schedules. The program walks you gently through the process—if you want a bit of advice, the Esc key pops up a window with a few words of wisdom. If the going gets rough, you are reminded to consult a tax accountant or government publication for intricate problems.

The program screens are arranged in a simple, clean format. Most screens are limited to six (or fewer) questions or instructions. Replicas of Revenue Service forms have been banished. There is a conscious effort to avoid "taxspeak."

For the intelligent layman who does not want to be dragged through the arcane reaches of technical tax details, *TaxCut*'s clean screen neatly avoids that miasma. On the other hand, I find it a bit like flying blind: *TaxCut* may not alert you to the implications of your entries in the same way as a program that puts all the calculations in front of you instantly or at the press of the PgDn key. (*TaxCut* will display the results when you choose the Print to Screen option, giving you a chance to go back and make changes before the final printout, but this procedure involves a few time-consuming steps.) And if you meet with unexpected results when you've completed the job, not having your calculations before you makes it more difficult to retrace your steps to the point where the program's use of your answer took an unexpected turn.

The compact on-screen calculator that Ctrl-N invokes consists of two cells in the lower-left-hand corner. It works fine with +, -, /, and * as its functions, while leaving a clear view of the rest of the screen.

Part of *TaxCut*'s grand plan is to allow users to import data from the *Managing Your Money* program. The company said that this will be possible if you buy or upgrade to the new 5.0 version of *Managing Your Money*, which should be on the market by the time you read this.

The results of a return can be previewed through the Print menu before printing. As with all the programs to be reviewed, the printouts of the supporting schedules can be filed. The company said that *TaxCut*'s 1040 is acceptable for filing if done on a dot matrix printer, but that part of the program was not available to test at the time of the review. The laser printout will need to be transcribed to an official Form 1040 manually.

List Price: *Andrew Tobias' TaxCut*, $79.95. **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. MECA Ventures Inc., 355 Riverside Ave., Westport, CT 06880; (203) 226-2400.

CIRCLE **686** ON READER SERVICE CARD

Preparation IS More Than Half the Game

Recently the IRS confessed that if you're a taxpayer filing a Form 1040 with a few schedules, it takes an average of 8 hours of hunting, gathering, and winnowing before you're ready to do the forms. Shoehorning the right numbers into the right boxes on the Form 1040 and its supporting schedules will take several more hours. Even seasoned veterans still wonder: What's the best way to prepare for this "taxing" experience?

First, collect all the official forms showing income received, expenses incurred, and taxes withheld. Then collect your own records, such as check stubs, bank statements, broker's confirmations, the books of accounts of your sole proprietorship, and those year-end analyses some credit card companies produce to help customers figure out where it all went and if any of it is deductible.

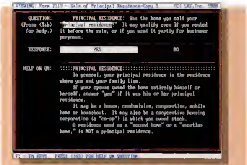
Second, decide what forms you need. Most of the tax programs we're reviewing have a preliminary interview or checklist to alert you to those forms that may apply to your situation.

Third, sort it out. Take care to distinguish income items from expense items. Many people both receive interest income and pay out interest expense. Make sure to group the income and expenses that go together on separate schedules.

Form 1040 serves as the summary of the details found in the other forms and schedules. For the most part, after keying in your basic identifying data and filing status, the tax programs work best if you do the supporting schedules first and let the program carry the results over to the 1040.

Finally, tackle your state return after you've finished the federal one. Most states base all or some calculations on the results that appear on your federal return.

You can avoid some (but not all) of this tedium if you have fed carefully labeled items into a financial management program all year. Some of the tax packages reviewed here import data directly from such programs.—**Laura Lou Meadows**



```
VIEWING: Form 2119 — Sale of Principal Residence-Copy 1        (C) LKS,Inc. 1988

   QUESTION:       PRINCIPAL RESIDENCE:  Was the home you sold your
 (Press <Tab>     "principal residence?"  It may qualify even if you rented
  for help.)      it before the sale, or if you used it partly for business
                  purposes.

   RESPONSE:                 YES                                NO

 HELP ON QN:      :::::PRINCIPAL RESIDENCE:::::::::::::::::::::::::::::::::::
                       In general, your principal residence is the residence
                  where you and your family live.
                       If your spouse owned the home entirely himself or
                  herself, answer "yes" if it was his or her principal
                  residence.
                       It may be a house, condominium, cooperative, mobile
                  home or houseboat.  It may also be a cooperative housing
                  corporation (a "co-op") in which you owned stock.
                       A residence used as a "second home" or a "vacation
                  home," is NOT a principal residence.

F1 = FN KEYS.  PRESS <TAB> FOR HELP ON QUESTION.
```

Ask Dan About Your Taxes *details the fine points of using the house for rental or business purposes.*

Ask Dan About Your Taxes

The unique feature of Legal Knowledge Systems' *Ask Dan About Your Taxes* is its expert-system approach to answering many of the sticky questions that come up in the course of filling out a tax return. While an increasing number of tax-return programs offer some degree of on-line instructions, *Ask Dan*'s interactive technique goes beyond a static recitation of rules and uses a series of branching questions to arrive at a response tailored to your particular situation.

Now in its second year, the $89.95 program has a host of other features and a sleek operation and feel that put it in the top ranks of personal tax programs. Start by selecting the Checklist from the Big Picture menu; here you'll answer over 70 questions to find out which forms you'll need to fill out. As you fill out the tax forms, the bottom lines of the screen show the available submenus that can be invoked with the Slash key. You don't have to press any keys to add up the tax forms: on my 80286-based IBM compatible, totals appeared instantaneously after each number was entered.

Press the F1 key once to list the features behind the other function keys, such as a scratch pad for recording lists too long for a tax form or an on-screen

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AFTER HOURS

PERSONAL FINANCE

Countdown to April 15: Four Personal Tax-Preparation Programs

BY LAURA LOU MEADOWS

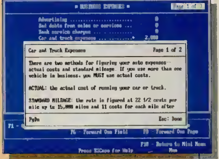
It is a rainy weekend in November, and I am awash in betas. Betas, for me, are not the second-class citizens of Aldous Huxley's *Brave New World* (who were not as good as the Alphas, but grateful to be better than the Gammas, who did the menial work). Rather, they are the creations of the tax-return software publishers—programs that have been sent out before their time.

Using beta versions means that not all of the programs' features were in well-oiled working order during the review period. The reasons? Namely, a late-breaking Tax and Miscellaneous Revenue Act of 1988, which Congress passed at the end of last October, plus the 3-month lead time of a magazine eager to bring you the news before your tax returns are due in the mail.

But even in their beta states, the nine tax-preparation programs reviewed here and in the following issue show the happy results of competition in a free market. Not only do features proliferate but, astonishing to say, getting the programs up and running is smoother than ever. Tax programs are picking up protocols and conventions familiar from the world of word processors and spreadsheets. Pull-down lists and pop-up menus abound. I won't say this makes the tax programs easy to learn—just easier than before.

In this issue, we look at four personal tax packages: *Andrew Tobias' TaxCut*, *Ask Dan About Your Taxes*, *J. K. Lasser's Your Income Tax*, and *TurboTax*. In the next issue, we'll follow up with an additional five packages designed to make dealing with the IRS less painful.

The most noticeable new feature in this year's batch of tax packages is the addition of more on-line instructions about tax rules. Often the help is context-sensitive and taken word for word from official government sources. You could get the same information by reading *J. K. Lasser's Your Income Tax* or some snappy government tome, but life is so much simpler if you don't have to plow through an index trying to guess whether the tax-writing wizards of Washington placed your answer under D for Deductible, E for Expense, N for Not a chance or T for Tough cookies.



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          Advertising ........................         0
          Bad debts from sales or services ...         0
          Bank service charges ... .........           0
          Car and truck expenses ... .......•      2,000

   Car and Truck Expenses                               Page 1 of 2

   There are two methods for figuring your auto expenses—
   actual costs and standard mileage. If you use more than one
   vehicle in business, you MUST use actual costs.

   ACTUAL: the actual cost of running your car or truck.

   STANDARD MILEAGE: the rate is figured at 22 1/2 cents per
   mile up to 15,000 miles and 11 cents for each mile after

   PgDn                                                 Esc: Done

F1 -
                  F6 - Forward One Field      F8 - Forward One Page
                                              F10 - Return to Mini Menu
                  Press ESCape for Help           Menu
```

Andrew Tobias' TaxCut gives you simple and direct explanations of what to do with your business vehicles on Schedule C.

Another welcome development: more programs now have the ability to print a Form 1040 that is valid for filing with the IRS. The IRS always rejects imitation Forms 1040 that merely type out the captions and taxpayer information, insisting that it has stipulated characteristics that few but laser printers with tax fonts can generate. (In the next issue we'll review two tax font cartridges for laser printers.) Last year, a number of tax-return programs came up with dot matrix 1040s that passed muster. This year, more programs include this feature, and several can replicate an acceptable Form 1040 on laser printers; some can do so even without a special font cartridge.

This year more tax programs are geared to import data from other sources, such as a financial planning program that you've been feeding carefully labeled items all year long or the spreadsheet where you've calculated the bottom line for your investments.

Only a few years ago, after reviewing a handful of tax-return packages, I was grousing in these pages (see "Tackling the Tax Problem: Information Organization," *PC Magazine*, April 2, 1985) that "the IRS may be the only outfit in the country with enough resources to do the job right." But since then, private industry has honed its skills and in many instances has developed software packages that do a thoroughly respectable job of producing tax returns.

Andrew Tobias' TaxCut

"Unlike Betty Crocker, I do, at least, exist," says Andrew Tobias, author of the popular *Andrew Tobias' Managing Your Money* financial program. An urbane and witty fellow in the flesh, his writings spice up anyone's 5-foot shelf of business books. Now, Tobias's deft style enlightens the screens and manual of *Andrew Tobias' TaxCut*, which is based on the now-defunct *PC/TaxCut*. MECA (which publishes the *Andrew Tobias* software titles) took over the *PC/TaxCut* software from Best Programs.

Not that Tobias claims to be a tax specialist, but he does have Price Waterhouse, the behemoth accounting firm, on retainer to keep an eye on the tax aspects of this year's edition of the $79.95 *TaxCut*. With such expertise around, MECA feels comfortable guaranteeing users that it will pay any IRS penalty caused by a calculation error

AFTER HOURS INDEX

Andrew Tobias' TaxCut
A clean and simple approach to taxes, from the author of *Andrew Tobias' Managing Your Money*

Ask Dan About Your Taxes
An expert-system approach to answering sticky tax questions

J. K. Lasser's Your Income Tax
Includes a paperback copy of *J.K. Lasser's Your Income Tax*, the do-it-yourselfer's tax bible

TurboTax
A fast, classy, and comprehensive tax program

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